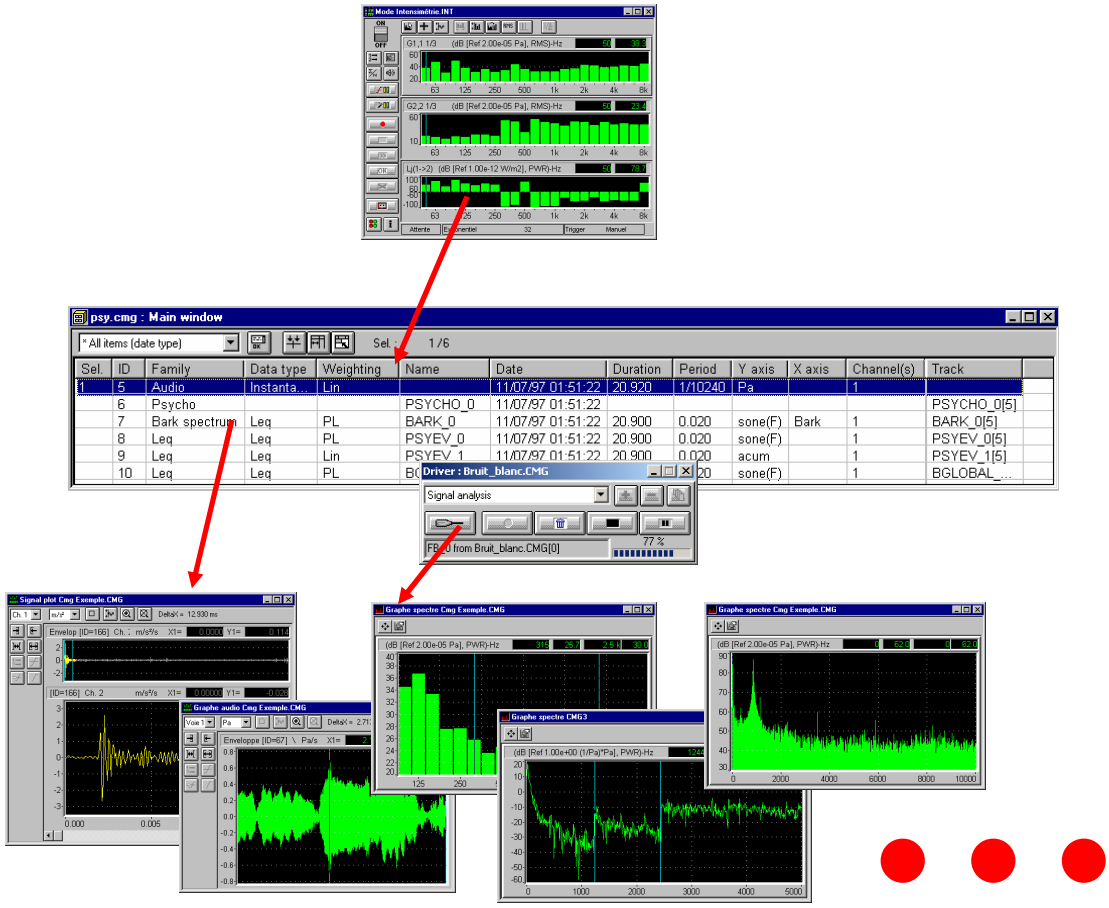
dBFA software suite

Frequency Analysis and much more...



AREVA

01dB-Metravib

USER MANUAL

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01dB-Metravib

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Frequency analysis software suite and much more…
User manual

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[1] **Important Notice**: Because this software package is modular in structure, some of the functions described in this manual may not be available in your copy of the software. To upgrade your version with optional modules, contact your 01dB-Metravib agent.

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1. DESCRIPTION OF A 01DB-METRAVIB PC-BASED MEASUREMENT CHAIN

You have purchased a 01dB-Metravib PC-based system to perform sound and vibration analysis. The 01dB-Metravib concept is to combine sound and vibration instrumentation with the computational and management facilities of a PC.

For first time users of a PC-based measurement chain, the following chapter describes the concept with respect to environmental noise measurements.

For more general information on the concept of a PC-based measurement system, see the "getting started user manual" delivered with your system.

1.1. Introduction

In recent years, there has been much written and said about the use of personal computers in acoustics and vibrations, both for measurement and results processing. The advances in PCs have been nothing short of phenomenal, driven by the fast moving requirements of information technology in the office environment, and these benefits are starting to filter into our world of acoustics, in the form of more flexible measurement tools.

The pure technologists amongst us would doubtless plunge headlong into building an instrument on a PC, which in principle is not a difficult job, but the resulting system must offer clear benefits to the user before it can be accepted as a true alternative to more dedicated instrumentation.

This is where one of the traditional divides has emerged between instruments and PCs. The stand-alone instrument has always been used to provide the measurements, and the computer has been used simply as a storage device for archiving and displaying results, with simple post-processing functions. The interface between the two has either been in the form of a simple RS-232 serial communication, or via manual entry of results from a paper printout. This latter in particular has been responsible for many errors, with the tedium of copying numbers into a spreadsheet, for example, from a long roll of silver paper!

It is only relatively recently that computers have moved into the measurement arena, supported by the massive increase in available processing power. However, to build a sensible instrument using a PC, we need to consider which processes are better handled by stand-alone hardware, and what can be transferred to the PC environment.

The use of personal computers for acoustical measurement and data processing has been a topic of much discussion, even controversy over recent years. The phenomenal growth in PC technology now offers the benefits of computational speed and flexibility that are being employed in many areas of research and engineering applications.

Traditionally the function of acoustical measurement has belonged to the stand-alone instrument while the computer has carried out the tasks of data storage, display and basic processing. The interface between the two has been either an RS-232 serial communication or manual entry via a keyboard. Human error, excessive time and long rolls of silver paper are just some of the disadvantages of this system.

An attractive solution for the pure technologist is to build a PC-based instrument, though the benefits over the stand-alone instrument should be apparent. Alternatively, the design of an optimum PC-based measurement system will depend on the management of data handling between the dedicated hardware and the PC environment. The possibility of flexible and creative solutions that offer a very high degree of accuracy over a wide range of applications have been sought and developed over the last fifteen years by the team at 01dB-Metravib.

1.2. General description

01dB-Metravib has developed a modular PC-based measurement chain, similar to that used by traditional stand-alone measurement systems. This generic approach also applies to sound level meters, tape recorders or multi-channel analysers.

First, the **transducer** transforms a physical phenomenon into an electrical input signal. Secondly **the signal-conditioning** block transforms and/or amplifies the input signal for treatment in an acquisition unit. Conditioners require power supply.

Control of the instrument and output of the results is required. Control is via key commands on a control panel. Results such as a spectrum or time history graphs may also be stored, for example as raw audio data, similar to a DAT recording or as a spectrum memory or set of Ln measurements. Results are then available at the convenience of the user for post-processing operations, such as building acoustics calculations.

Finally, the instrument may have an interface to a computer for further analysis and reporting.

The **personal computer** may be used as a host to a stand-alone instrument. Duplication of function, however, quickly becomes apparent. A PC may handle many internal functions of the dedicated instrument more efficiently. Benefits of the PC include access to greater storage capacity, input/output devices, higher resolution with a Windows™ style graphical interface and general integration with the computer based design environment. The computer may also take responsibility for system control. Note that some existing analysers actually feature an internal x86 PC processor as the system controller!

As graphics, user interface, storage and post-processing are all handled by the PC platform, and the type of measurement performed is defined simply by the application software running on the computer, which sends calls to the hardware resources as necessary.

The **Level of Accuracy** achieved by a Sound Level Meter is determined by its grade, and is regulated by the legal requirements of the Standards IEC651, IEC804, IEC1043 and their national equivalents. Minimum requirements are given in respect of dynamic range, linearity, frequency response and indications.

What is a PC based measuring system? It is a system comprising hardware resources, software modules and a host computer, which must meet the current Standard specifications for its class. The requirements currently reflect the use of dedicated instruments, but until they are revised, the new instruments must still comply.

01dB-Metravib is dedicated to the design and development of portable PC based measurement systems that offer a very high degree of accuracy and are intuitive to use in all aspects. Our systems are type 1 approved in several countries. This accuracy rating applies to the use of generic computing hardware, that in practice enables any brand of computer to be used that meets current minimum standards.

1.3. Industrial applications

To perform sound and vibration measurements with a 01dB-Metravib PC-based measurement chain, this is the list of the hardware elements required. This list is non-exhaustive and may vary from application to application.

Transducer unit (dual channel measurements in option)

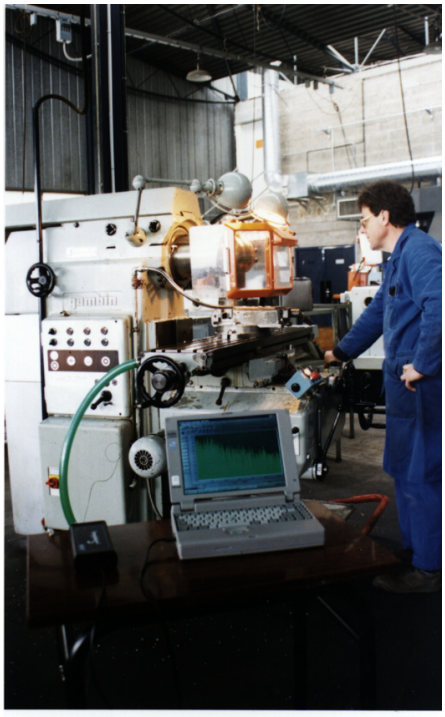
- Type I or Type 2 condenser microphone (pre-polarised, externally polarised)
- Associated preamplifier. It should supply the polarisation voltage for the condenser microphone if required.
- A sound intensity probe (with remote control) for sound intensity and sound power measurements.

Accessories

- Windshield to protect the microphone (or an all weather windshield or an outdoors microphone unit).
- Extension cable for connection to the acquisition unit.
- Tripod.
- Measurement case.
- Type 1 or Type 2 acoustical calibrator to perform calibrated measurements.

Measuring instrument

- Notebook, industrial or desktop computer, that meets the minimum requirements specified by 01dB-Metravib, with a Windows 2000 or Windows XP operating system.
- Acquisition unit connected to the Notebook (e.g. SYMPHONIE box).
- dBFA suite acquisition and processing software with optional modules.



The photograph illustrates a field vibration measurement on a rotating shaft in an industrial area with a 01dB-Metravib measurement chain.

All these elements can be purchased from 01dB-Metravib. Contact your sales' representative for more information.

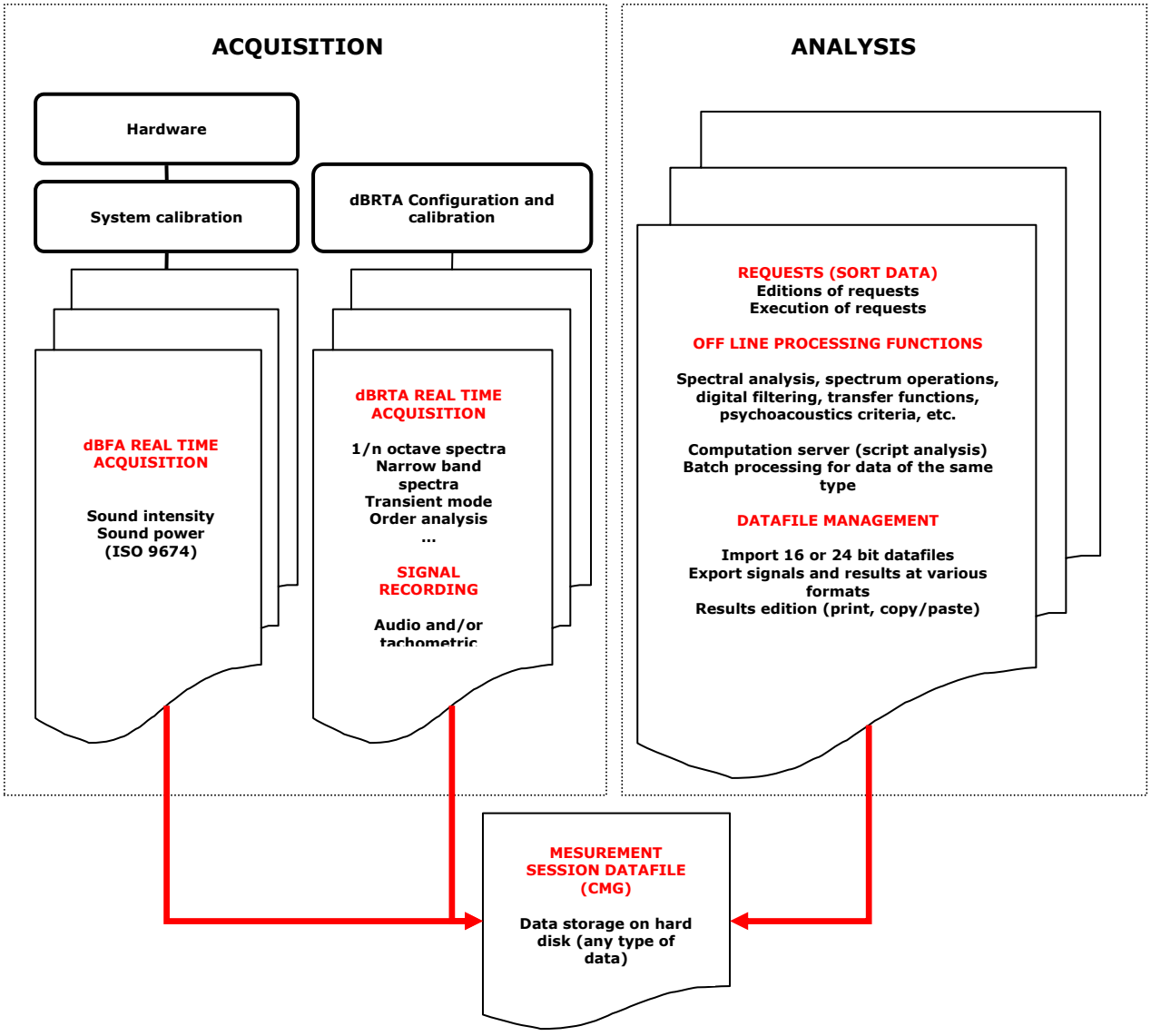
A complete description of how these different elements interconnected is given in the getting started manual delivered with your system.

2. ACQUISITION & ANALYSIS WITH DBFA

2.1. Overview of the software package: principle of operation

dBFA suite allows the user to perform data acquisition and analysis at the same time. There is a sequence of steps that the user should follow. This will lead not only to successful measurement but also to rapid familiarity with the software.

The flow diagram below describes the overall structure of **dBFA suite** software package:



All noise and vibration data acquired, as well as any analysis result, are saved in a database called a measurement session datafile (with a *.CMG extension).

The procedures for each type of measurement, as well as each data processing operation, are described in the following paragraphs. The stages common to each type of measurement are also described.

Each procedure is then described in details in the different chapters of this manual.

2.2. Measuring with dBFA

Since dBFA 4.6, real-time measurement (except intensity measurement) are performed in the new real time modules. Please, refer to ***dBRTA user manual*** available on the installation CD.

2.2.1. Common steps (Intensity mode, Sound Power)

These steps are necessary only for Intensity ans Sound Power measurement.

❑ **Stage 1: Set up of the measurement chain**

Connection of the hardware elements, definition of their characteristics in the database utility **dBCONFIG**, set up of the signal conditioning options of both the transducer and the hardware peripheral.

📖 *Refer to the installation manual delivered with your system for more details*

❑ **Stage 2: Selection of acquisition hardware: one or more transducer / calibrator pair**

Choose **Acquisition / Hardware Configuration.** Select the acquisition platform (and associated signal conditioning options), the correct transducer and calibrator pairs, etc.

❑ **Stage 3: Calibration**

Carry out the calibration of the measurement chain before each measurement (Command **Acquisition / Calibration**). Refer to **chapter 7.**

❑ **Stage 4: Choice of the type of measurement**

Open a new measurement set-up (Command **Acquisition / New measurement set-up**) or open an existing one (Command **Acquisition / Open measurement set-up**) to perform a real-time acquisition.

The user may choose to perform the following types of real-time acquisition:

- Sound intensity (*.INT) – Intensimetry Mode file. See **Chapter 8**.
- Sound power (ISO9614) - **File / New / ISO9614 campaign** command.

Measurement configuration contains all the parameters associated with a measurement.

2.3. Data processing with dBFA

Data processing in **dBFA** can now be performed in a global manner thanks to the implementation of analysis scripts. Each processing operation is available as an **operator**, which assembled in series or in parallel composes an analysis **script**. The scripts available in the application software are regrouped in a **calculation server**, with a user interface to configure and run an off-line analysis.

Using off-line **batch** processing, it is also possible to process a set of data items according to a given analysis script.

We present in the following paragraphs the procedures allowing the user:

- To generally manage measurement session datafiles (open, save, close, print, copy/paste, etc.)
- To sort measurement data items in a measurement session datafile
- To configure processing functions in an analysis script
- To execute an analysis script with the calculation server
- To import 16-bit datafiles (for users of 01dB-Metravib PC-based systems with 16-bit version software packages)
- To export audio/signal events at the Microsoft WAV format
- To edit a measurement / test report.

The first action for data analysis is to open an existing measurement session (command **File / Open**) that contains the measurement data items to analyse.

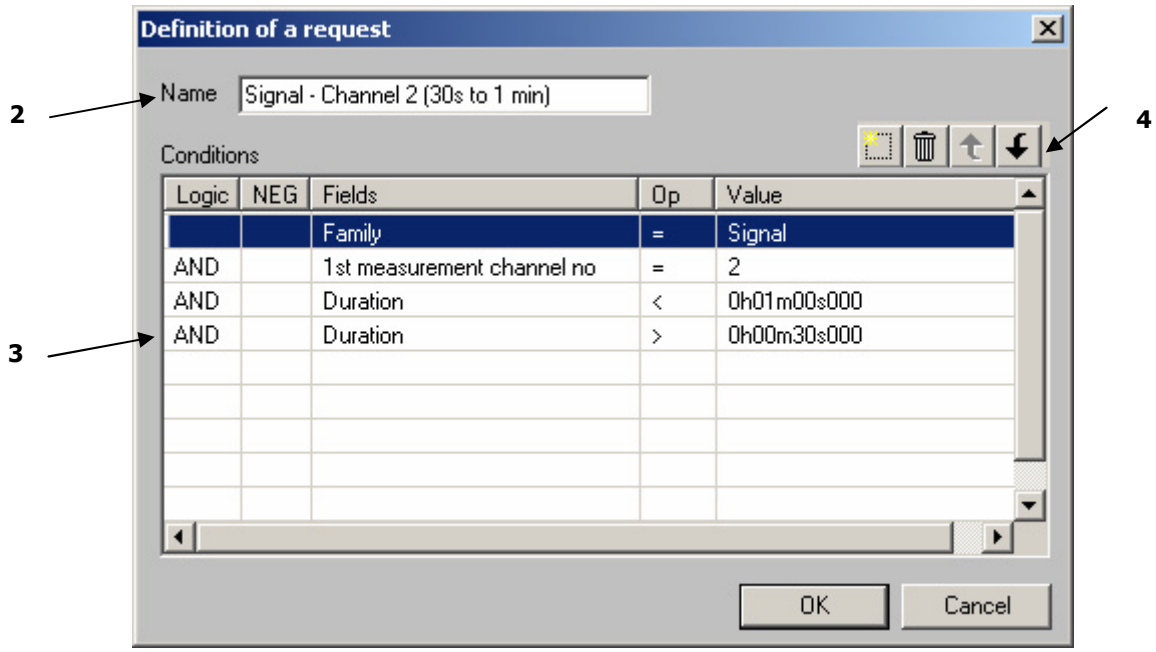
2.3.1. Requests (data sorting)

Measurement session datafiles have a structure similar to databases. As any measurement result is stored into these datafiles, a set of requests functions allow the user to sort the data according to various parameters.
One can display, for example, data items of the same family only (signals, narrow band spectra, octaves and third octave spectra, etc.) in the measurement session view.

📖 *See **chapter 3.6** for more details.*

❑ **Stage 1: Editing of requests**
Use the command **Datafile / Edition of requests** to open the dialog box that allows the user to define, edit or remove requests.

dBFA manages two types of requests: **local requests**, which apply only to the active measurement session, and **global requests**, which apply to any measurement session.
The procedure to define a request is the same in both cases. Follow the instructions below to **add** a new request or **edit** the current request:



❑ **Stage 2: Request editing**
Give a name to the current request.

❑ **Stage 3: Define the logical conditions of the request**
Define all the required conditions of the request. Start by the **Fields** field: select a given type of information, then its value. If more than condition is defined, select the Boolean operator (AND/OR) that will define the interactions in-between the request conditions.

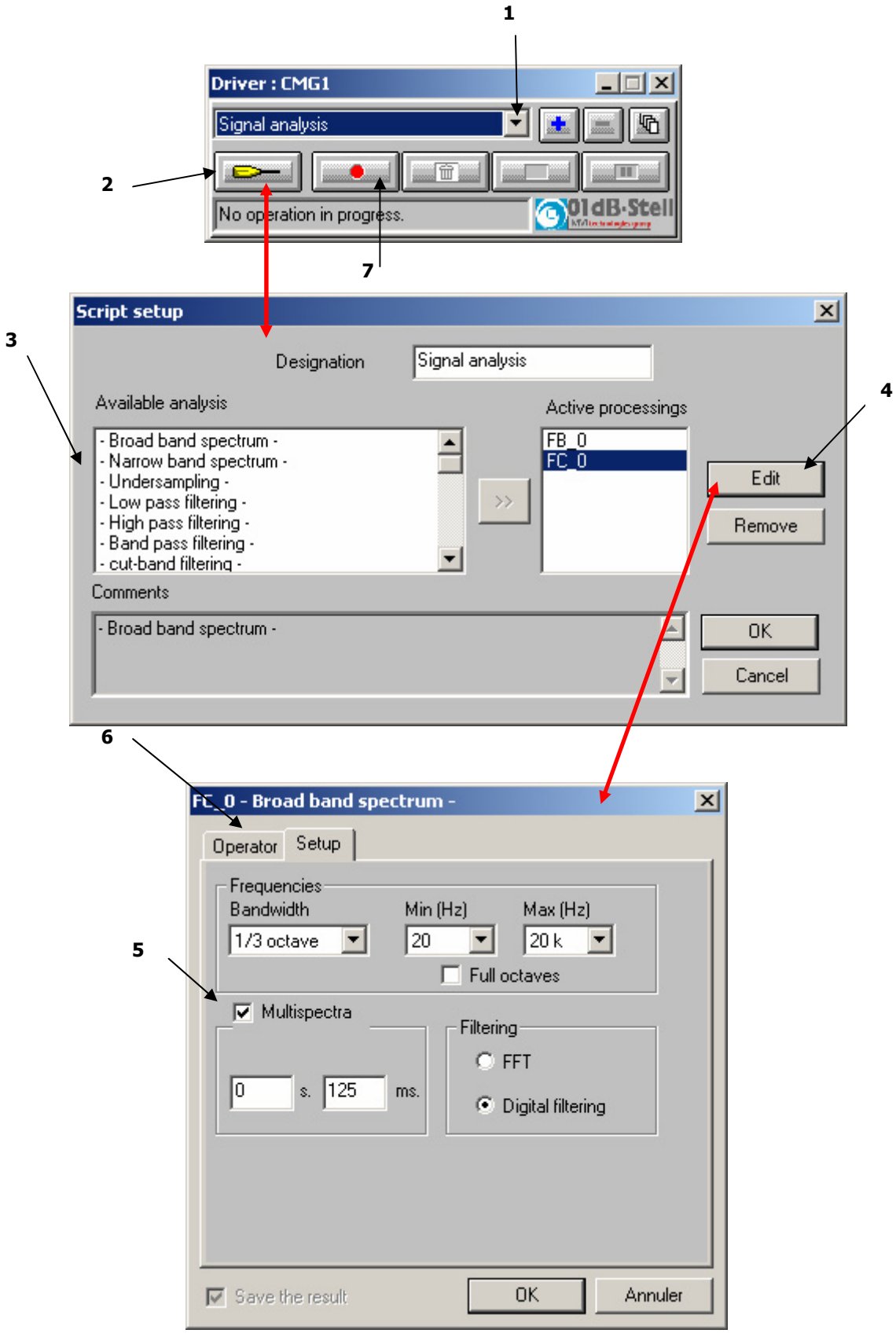
❑ **Stage 4: Management of the request conditions**
Define the order of the conditions, remove a condition, add a condition, etc.

❑ **Stage 5: Run the request**
Use the command **Datafile / Current request** or select the request in the scrolling list of the measurement session toolbar to execute it.

In the above example, after execution of this request, the following data items only will be listed in the measurement session window: audio events acquired on channel 2 of duration ranging from 30 seconds to 1 minute. Signals will then be sorted according to their duration by clicking on the title of the field called "Duration" in the measurement campaign.

2.3.2. Off-line processing analyses

Use the corresponding icon or the command **General / Calculation** server to initiate the calculation server that allows the user to configure and execute an analysis script. The following sketch illustrates the off-line analysis process:



❑ Stage 1: Select an analysis script / script management

Select with the mouse in the measurement session window all the data items to (example: audio records). Then select in the list of the calculation server dialog box a pre-defined analysis script (e.g.: audio analysis), or a user-defined script (that can be created with the corresponding icons).

❑ Stage 2: Edition of the analysis script

Click with the mouse on the corresponding icon to display the script configuration dialog box.

❑ Stage 3: Select the required processing functions

Select in the list of **available processing** functions the different types of analyses required and then pass them into the list of **active processing** functions.

❑ Stage 4: Edit the required processing functions

In the list of **active processing** functions, select the function (or operator) to configure and click on the **Edit** button. Repeat stage 5 and 6 for each active processing function.

❑ Stage 5: Configure the processing function

In the **Configuration** tab, define the analysis parameters.

❑ Stage 6: Additional configuration

In the **Operator** tab, input a user-defined name for the processing function.

❑ Stage 7: Execute the analysis script

Once all set-up operations have been carried out, validate all the dialog boxes and click on the corresponding icon to execute the analysis script.

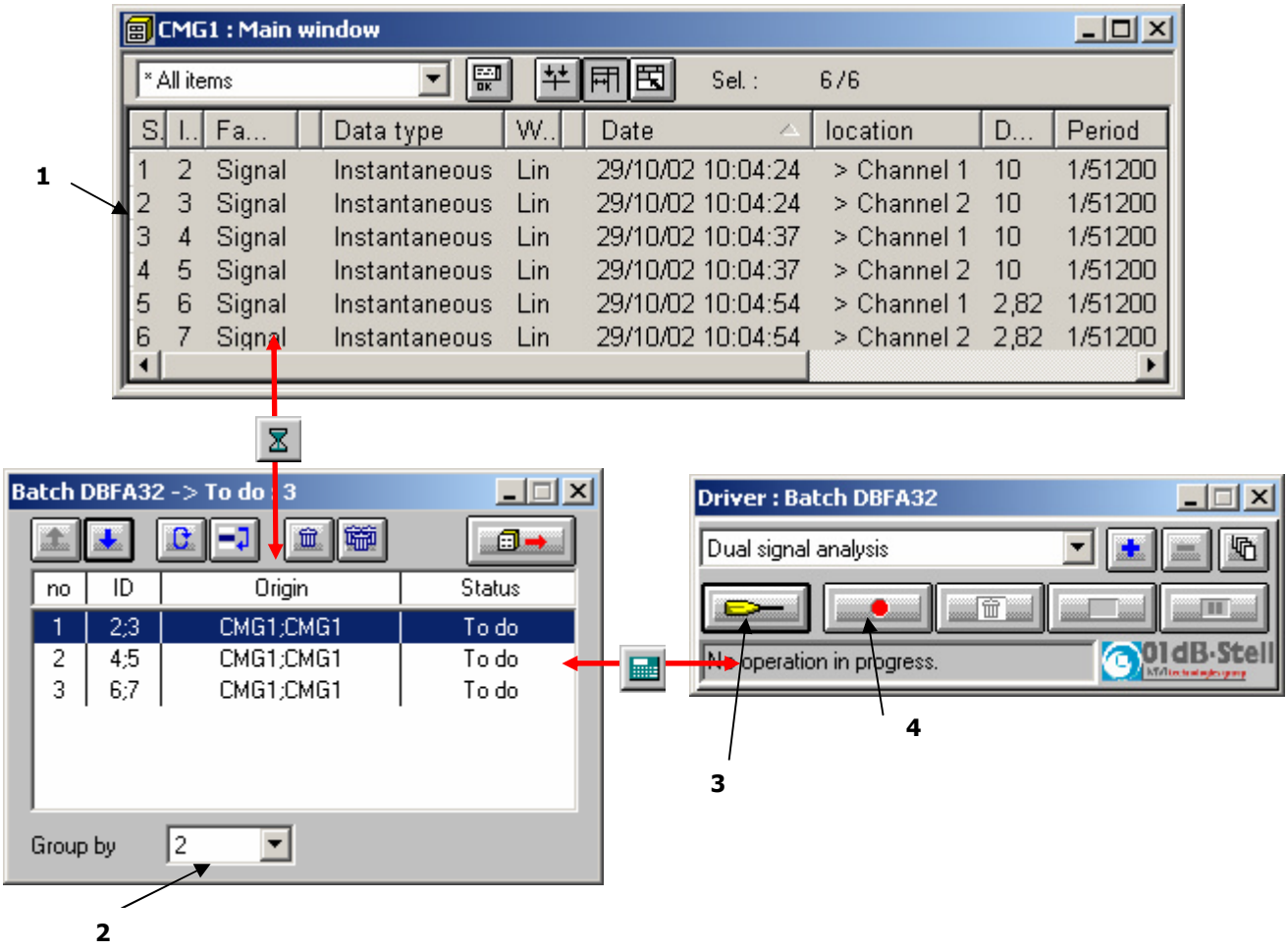
The various processing functions are then executed sequentially for the selected data items in the measurement session window.

The analysis results are then stored themselves in the active measurement session datafile.

📖 *Refer to **chapter 4** for more details on the off-line processing process*

2.3.3. Batch processing

It is possible to run a batch on a set of data to process a script on all these data.
For instance, if the user wants to apply the same script on several items of the measurement session, he can define a set of input items on which the script will be run automatically.


CMG1 : Main window
* All items
Sel. : 6/6
S. I.. Fa... Data type W.. Date location D... Period
1 2 Signal Instantaneous Lin 29/10/02 10:04:24 > Channel 1 10 1/51200
2 3 Signal Instantaneous Lin 29/10/02 10:04:24 > Channel 2 10 1/51200
3 4 Signal Instantaneous Lin 29/10/02 10:04:37 > Channel 1 10 1/51200
4 5 Signal Instantaneous Lin 29/10/02 10:04:37 > Channel 2 10 1/51200
5 6 Signal Instantaneous Lin 29/10/02 10:04:54 > Channel 1 2,82 1/51200
6 7 Signal Instantaneous Lin 29/10/02 10:04:54 > Channel 2 2,82 1/51200
1
Batch DBFA32 -> To do : 3
no ID Origin Status
1 2;3 CMG1;CMG1 To do
2 4;5 CMG1;CMG1 To do
3 6;7 CMG1;CMG1 To do
Group by 2
2
Driver : Batch DBFA32
Dual signal analysis
No operation in progress.
01dB-Stell
3
4

❑ **Stage 1: Selection of data items**
Select with the mouse in the measurement session window all the data items for which a batch analysis will be performed then click on the corresponding icon or use the command **Datafile / Batches** to open the batch processing dialog box

❑ **Stage 2: Group data items**
In the batch dialog box, group data items for the analysis. By default, each item is processed on its own, one after another (Groups of 1 in between X items). However, it is possible to group several data items together in order to perform arithmetic operations (addition, subtraction, averaging) or to calculate a cross-spectrum.

❑ **Stage 3: Configuration of the batch processing operations**
Click on the corresponding icon to display the analysis script configuration dialog box. Refer to **paragraph 2.3.2** for more details on how to configure an analysis script.

Be careful, the title bar of the calculation server must feature "PILOTE: BATCH FOR..." in order to configure and run an analysis script in the batch mode. If this text is not displayed, click again on the batch dialog box.

❑ **Stage 4: Execution of the batch processing**

Once the set-up operations have been carried out, validate all the dialog boxes and click on the corresponding icon to start the batch analysis. The different processing operations of the analysis script are executed for the data items grouped and locked in the batch dialog box. The analysis results are then stored in the active measurement session datafile.

🕮 *Refer to **chapter 5** for more details on the batch analysis process.*

3. MANAGEMENT OF MEASUREMENT SESSION DATAFILES (CMG)

Any data acquired in **dBFA** is stored in a **measurement session** datafile (*.CMG extension). From this datafile, the user can perform a given analysis (for example, calculation of a narrow band average spectrum from a signal recording).

From the measurement session window, it is possible to print tables of results and graphics, to copy and paste data items to a spreadsheet or word processor for further analysis and for editing a measurement report.

This chapter deals with the following aspects of data processing:

- **General operations on the measurement session datafiles**

  Description of the measurement session window, comments, information window, delete data items, display graphics and table of results, export data into a spreadsheet or word processor, start an off-line analysis, start a batch analysis.

- **Requests (sort data items)**

  Edition of requests, execution of requests.

📖 *The different types of off-line processing functions, as well as the analysis process, are dealt with in **chapter 4**.*

📖 *Batch analysis is dealt with in **chapter 5**.*

📖 *Be careful, if you have the ISO9614 module for sound power determination, the measurement session can be displayed as standard (see this chapter) or in a specific manner. Refer to the corresponding application note in the latter case.*

3.1. CMG datafile management

A measurement session data file, with the CMG extension, may represent several megabytes of data and **dBFA** may work simultaneously on several data files.

📖 *In order to facilitate session management, elements can be moved from one session to another by dragging them with the mouse like in Windows Explorer.*

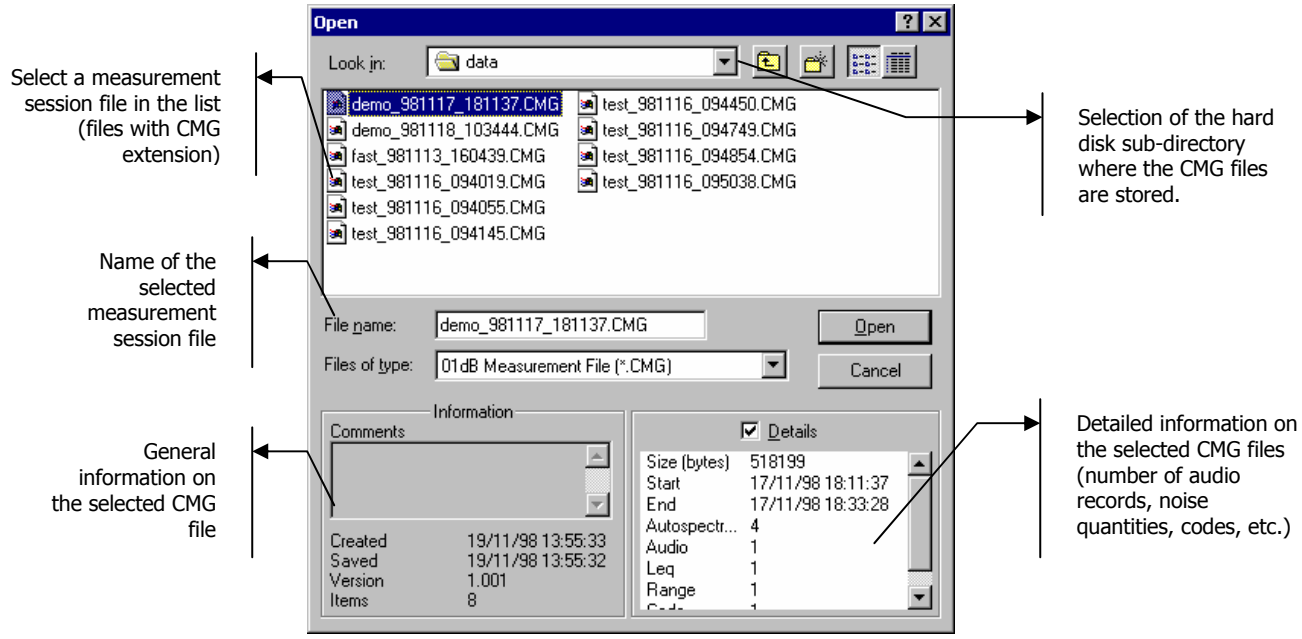
3.1.1. New CMG datafile

To create a new measurement session datafile (*.CMG) that is empty, click on the icon or use the **File / New (CTRL+N)** command.

An empty measurement session is then displayed on screen.

3.1.2. Open a CMG datafile

To open a CMG measurement session file stored on the computer hard disk, click on the icon or use the command **File / Open**. The following dialog box appears on screen.



The upper part of this dialog box allows the user to select a measurement session file CMG for processing in **dBFA** by choosing the appropriate location on the hard disk.
The lower part of this dialog box is activated when a CMG file has been selected in the list. Various information on the datafile is given such as:

- The date and time the file has been first recorded and when it was last saved, the version and the number of items contained in the CMG file.
- By ticking the **details** box, the size in bytes of the datafile, the start and end dates of the measurements, the number of events (signal recordings, spectra, etc.), as well as general parameters (dynamic range, number of codes, etc.)

Once a file has been selected, click on the **Open** button to open the datafile and proceed with its analysis.

3.1.3. Close a CMG datafile

To close a measurement session file of CMG type, use the command **File / Close**. Closing down the window of the datafile will also result in closing the CMG datafile. All others windows (results' listings, plots, etc.) will be closed as well.

dBFA will also prompt the user to save this CMG datafile if any modifications have been made to it before closing.

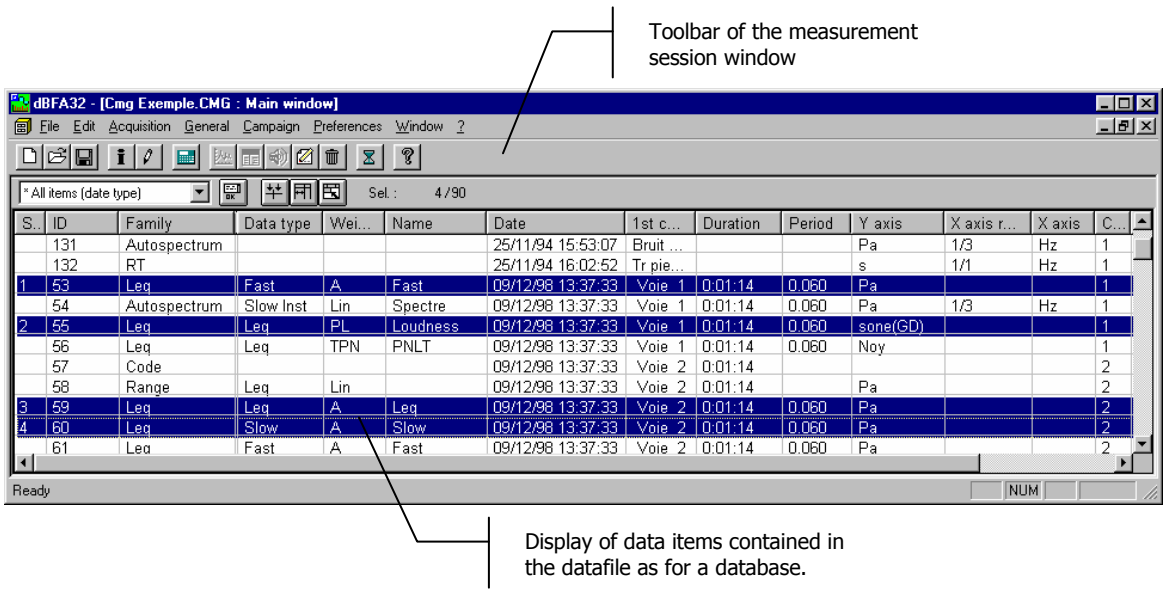
3.1.4. Save a CMG datafile

Use the command **File / Save (CTRL+S)** or **File / Save As** to save the measurement session on the computer hard disk

3.1.5. Delete one or several CMG datafile(s)

Use the command **File / Delete session(s)** to delete one or several measurement session datafiles, including temporary files. A dialog box is displayed on screen in order to select the datafiles to delete.

3.2. Measurement session window overview


Toolbar of the measurement session window
dBFA32 - [Cmg Exemple.CMG : Main window]
File Edit Acquisition General Campaign Preferences Window ?
* All items (date type)
Sel. : 4 / 90
S.. ID Family Data type Wei... Name Date 1st c... Duration Period Y axis X axis r... X axis C...
131 Autospectrum 25/11/94 15:53:07 Bruit ... Pa 1/3 Hz 1
132 RT 25/11/94 16:02:52 Tr pie... s 1/1 Hz 1
1 53 Leq Fast A Fast 09/12/98 13:37:33 Voie 1 0:01:14 0.060 Pa 1
54 Autospectrum Slow Inst Lin Spectre 09/12/98 13:37:33 Voie 1 0:01:14 0.060 Pa 1/3 Hz 1
2 55 Leq Leq PL Loudness 09/12/98 13:37:33 Voie 1 0:01:14 0.060 sone(GD) 1
56 Leq Leq TPN PNLT 09/12/98 13:37:33 Voie 1 0:01:14 0.060 Noy 1
57 Code 09/12/98 13:37:33 Voie 2 0:01:14 2
58 Range Leq Lin 09/12/98 13:37:33 Voie 2 0:01:14 Pa 2
3 59 Leq Leq A Leq 09/12/98 13:37:33 Voie 2 0:01:14 0.060 Pa 2
4 60 Leq Slow A Slow 09/12/98 13:37:33 Voie 2 0:01:14 0.060 Pa 2
61 Leq Fast A Fast 09/12/98 13:37:33 Voie 2 0:01:14 0.060 Pa 2
Ready
NUM
Display of data items contained in the datafile as for a database.

In the measurement session window, the data items are displayed as for a database. Each line corresponds to a given type of data (audio event, spectrum, etc.) and each column corresponds to a given type of information about this data item (name, weighting, frequency or time resolution, etc.)

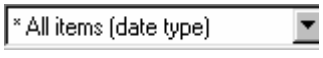
The horizontal toolbar allows the user to perform general and data processing operations for the data items contained in the measurement session.

Select data items in the list and perform the desired operation.
Items can be duplicated by using the keypad CTRL-C / CTRL-V. In this case, the data are also copied to the clipboard for external use. For a single duplication in dBFA, prefer the keypad SHIFT-CTRL-C / CRTL-V. This will prevent from using memory resources of your computer.

3.2.1. Toolbars

The following operations are possible for the data items contained in a measurement session file. According to the type and number of items selected in the list, some operations may not be activated.

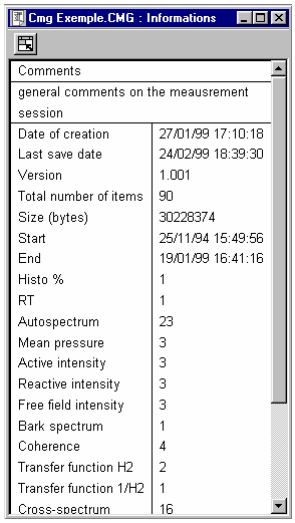
- Create an empty measurement session file (CTRL + N)
- Open an existing measurement session file (CTRL + O)
- Save the active measurement session file (CTRL + S)
- Display an information window about the measurement session
- Edit the general comment of the measurement session
- Launch the operation server (off-line analysis) See **chapter 4**
- Display a window to create a test report
- Display a multispectrum (sonagram)
- Plot (graphics) the selected data items
- List (table) the selected data items
- Playback the selected signal recordings
- Modify a data item (date, level correction, etc.)
- Delete the selected items
- Start a batch processing analysis - See **chapter 5**
- Open the index on the on-line help system
- Shortcut for predefined operator script



Sort data items according to the selected request

- Edit requests
- Select the window columns to display
- Automatically adjust the width of each column
- Automatically adjust the size of the measurement session window

3.2.2. Measurement session information window



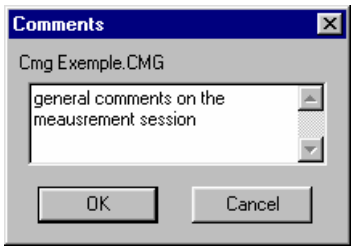
Use the command **General / Session Information** to display the information window of the active measurement session.

The following information is given in this window:

- Date of creation and last modification
- Number of data items contained in the datafile
- Datafile size
- Start and end date and time
- Number of data items of each family

This list is updated automatically each time a modification is made into the measurement session datafile.

3.2.3. Measurement session comments

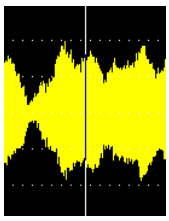


Use the command **General / Session comments** to input a general comment for the active measurement session datafile.

Comments are visible in the measurement session information window.

3.2.4. Playback of signal recordings

Select a recording in the list and use the command **Datafile / Replay** to playback a recording through the sound system of the computer (signal output of **SYMPHONIE** or integrated sound card). The dialog box shown aside is displayed on-screen during playback.



When a plot is displayed in dBFA, a **vertical cursor** follows the progress of the playback on this plot.

3.2.5. Delete data items

Select the data items to remove in the list and use the command **Edit / delete** or the **Delete** function key. After confirmation of the deletion, the data items are completely removed from the measurement session file.

3.2.6. Modify data items (editing)

Select one or several data items in the list and use the command **Datafile / Modify** to edit general parameters of these items. The user may modify the following parameters for each item:

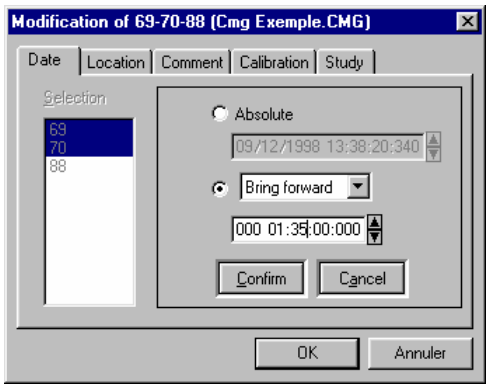
- The start date and time
- The location and comment defined during acquisition
- The study zone of the item

Furthermore, it is possible to apply a calibration correction (level in dB) for some given types of data items.
For Signal items, an Information tab is available.
For autospectra resulting from building acoustics measurements, the measurement channel can be assigned a type.

Each item is identified in the measurement session by its **identifier (ID)**. This identifier is a number.

To simplify the processing of measurement sessions, location, comments and date of the elements of a session can be entered directly by clicking on the appropriate files when the element is selected.

3.2.6.1. Editing of items: date and time

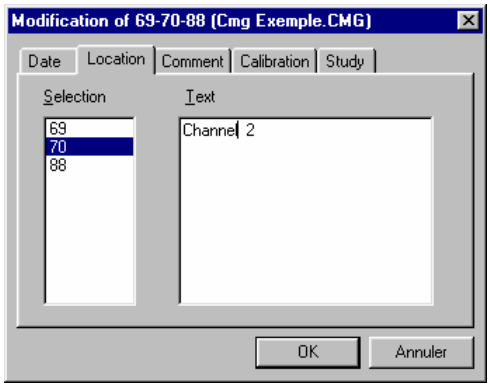


In the **Date** tab, edit the date and time values, corresponding to acquisition start, for the selected data items.

The modification can be performed in an **absolute** manner (direct editing of the date and time) or by bringing forward or putting back the original date by a user-defined duration (format: Day / hour / minutes / seconds / milliseconds).

The user has to **confirm** each date and time modification.

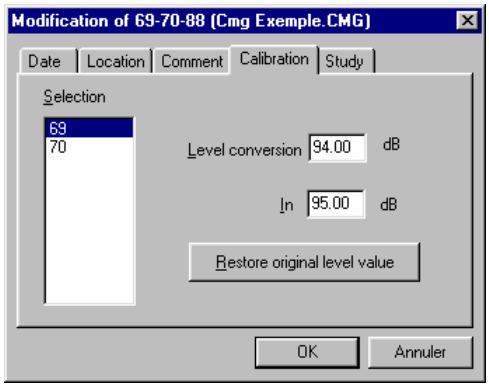
3.2.6.2. Editing of items: location and comments



In the **Location** tab, edit the comment relative to the location of the measurement channel.

In the **Comment** tab, edit the comment relative to, for example, the measurement conditions.

3.2.6.3. Editing of items: level conversion

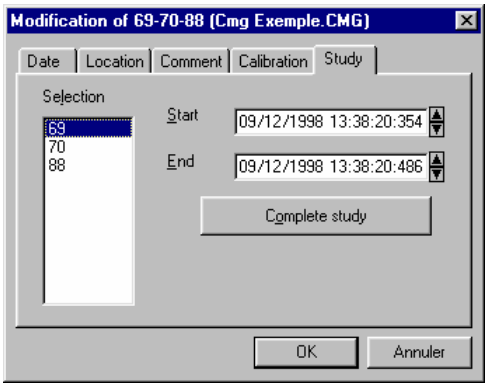


In the **calibration** tab, define a calibration adjustment for the selected data items.

A calibration level conversion in decibels is applied globally with a resolution of 0.01 dB.

Click on the key **Restore original level value** to cancel the level correction.

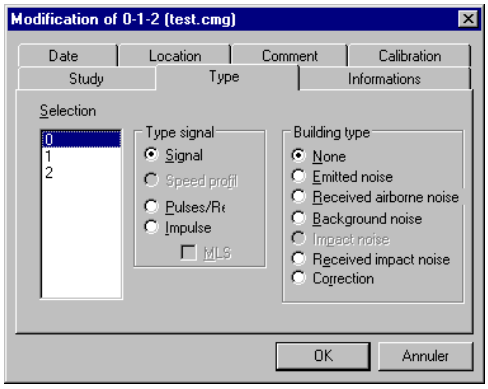
3.2.6.4. Editing of items: study zone



In the **study** tab, select the study zone for any subsequent analysis.

Click on the **Complete study** key to select the complete duration of the data item for an analysis.

3.2.6.5. Autospectrum type or Signal type



In the **Type** tab, select the type of a given autospectrum for building acoustics calculations.

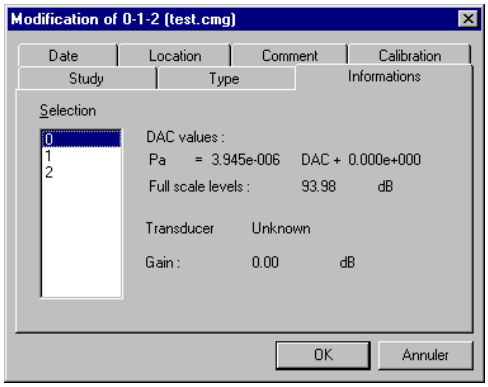
3.2.6.6. Information

• DAC conversion value

Conversion value to go directly from the digital value of the acquisition card to the analogue value in Pa.
This value depends on the transducer sensitivity and on the gain.

Example:

For the **SYMPHONIE** acquisition platform, the sampling is performed on 16 bits, i.e., on values ranging from –32768 to +32768.
For a value of 5000, the level in m/s^2 is 5000 × DAC, i.e., 5000 × 3.432^{e}-4 = 1.716 m/s^2



- **Full-scale level**

Maximum value (in dB) that can be measured with the current ADC value.
For **SYMPHONIE**, this value is equal to:
20 log [(32768×CNA) / P_0] in dB
with the reference pressure P_0 = 20 µPa

- **Type of transducer** used to acquire the signal

- **Gain** on the input signal

3.3. Plot data items (graphics)

Use the command **Datafile / Plot**, after selection of one or several data items in the list, to display the data in a graphical manner, when possible. The data are displayed either in different windows, or in the same window, stacked or superimposed depending on the elements selected. Double click on a data item in the list to also display a graphical view.

Data items of the following types may be displayed graphically in **dBFA**:

Signal editing view

- Signal recording (signal or tacho)
- Leq levels and sound pressure levels (Fast, Slow, Impulse) versus time
- Psychoacoustic criteria versus time
- Impulse response
- Speed profile (tachometry)

Broad band spectrum and/or multispectrum view

- Octave, third octave, 1/Nth octave band spectra
- Bark band spectra
- Active reactive and free-field intensity spectra
- Histograms and cumulated histograms
- Echograms

Narrow band spectrum and/or multispectrum view

- Narrow band autospectra and cross spectra
- Transfer functions
- Coherence
- Active reactive and free-field intensity spectra

Sonagram view

- Multispectra

Lissajous view

- Between two Signal items

Nichols/Nyquist view

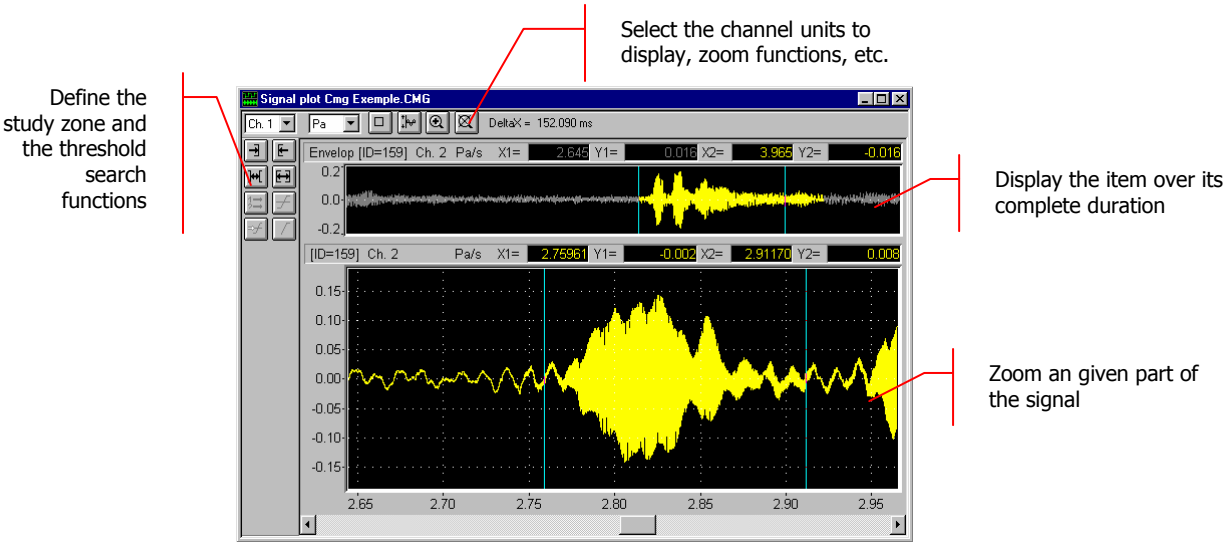
- Transfer functions and cross spectra

Let us now describe each view in the following paragraphs.

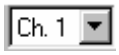
When several graphic windows are displayed, a synchronisation of the cursors on all open views is possible, provided dates are identical. For instance, if a signal is displayed, along with a multispectrum, and if the cursor is displaced on the signal view, then it will do the same on the multispectrum view. Use the Session / Time synchronisation menu or the *button in the toolbar to activate this function.*

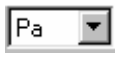
3.3.1. Signal view

In this type of graphical view, any time history of a signal (in physical units), noise and vibration quantity (level in dB or in physical units) can be displayed. An example of signal view is given below:


Select the channel units to display, zoom functions, etc.
Define the study zone and the threshold search functions
Signal plot Cmg Exemple.CMG
Display the item over its complete duration
Zoom an given part of the signal

Several Signal items can be displayed in the same signal-editing window if there were multiple selections in the measurement session. It is then possible to link the cursor displacement on all views by holding down the CTRL key while moving one cursor or by pressing the key.

 Select the active channel for the view

 Select the display unit

Activate/ Deactivate automatic autoscale for the zoom

Perform an autoscale in the signal zoom view

Activate the zoom view

Deactivate the zoom view

Cursor synchronisation when several signals are displayed

Beginning of the study zone

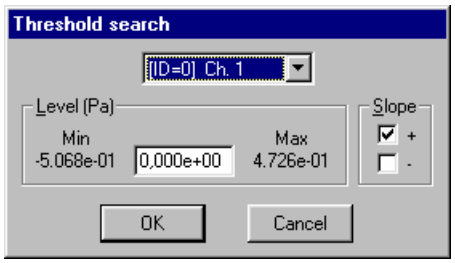
End of the study zone

Define the study zone in between the cursors

Define the study zone over the complete duration of the item

Show/Hide a channel and activate/deactivate a channel for any subsequent study

The vertical toolbar allows the user to define the study zone for the signal and to perform threshold search operations.



The threshold search command (command **Study / Threshold / Search)** allows the user to define the level of the threshold (value given in physical unit) and a slope (positive or negative) to the threshold condition.

When the threshold condition has been fulfilled, the cursor is located at the threshold exceeding on the graphical view.

The command allows the user to stop the threshold search and the command allows the user to find the next threshold exceeding.

The horizontal toolbar allows the user to define display parameters of the graphical view. It is possible to use **zoom** functions to zoom a part of the signal and perform an **autoscale** for the zoom view.

The display units depend of the type of graphical view.

For **signals**, it is possible to select the following display units:

- **DAC**: Displays the dynamic in dB converter. It is a relative decibel level. The 0dB level is the full-scale value of the converters (i.e. a sample which has a numerical value of 2 16 (32767) corresponds to the 0dB value). dBDAC values are always negative between 0 and -90dB.
- **V**: Dynamic display in Volts.
- **Physical unit**: If the transducer is a microphone, the dynamic is displayed in Pascals (**Pa**), if the transducer is an accelerometer, the dynamic is displayed in Acceleration (**m/s²**).

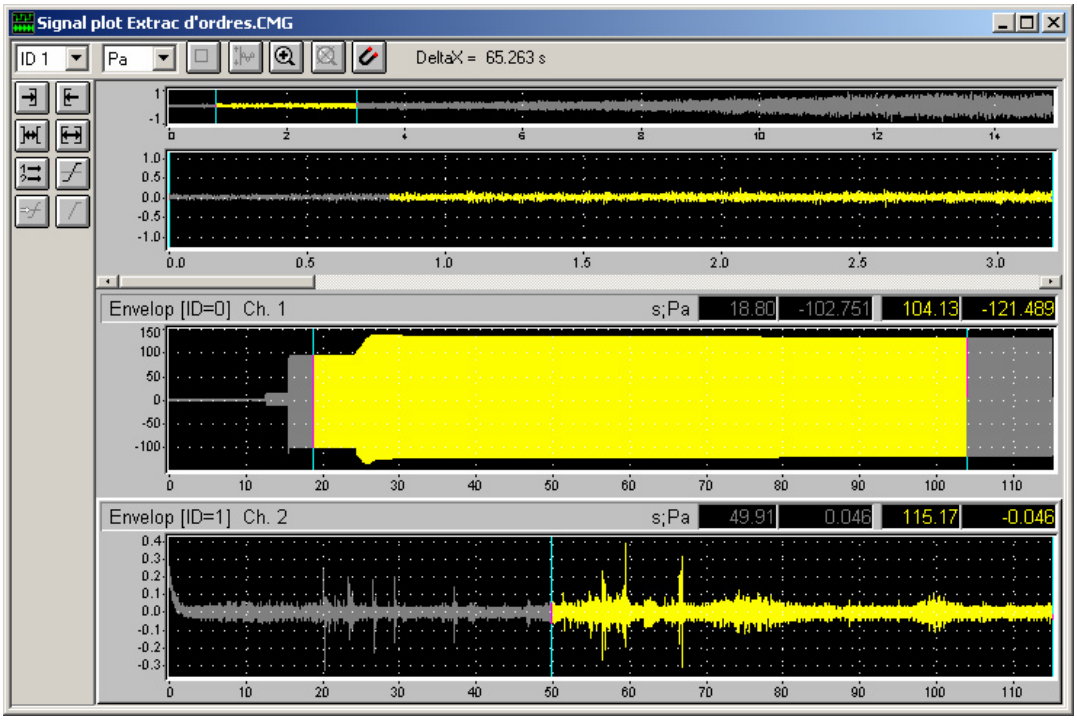
For sound and vibration quantities of type autospectrum, cross-spectrum and transfer functions, it is possible to select the following display units:

- **dB**: Level in decibels of the considered quantity (Leq, Slow, Fast, Impulse, etc…)
- **RMS (Root Mean Square)**: Average quadrate value for all the instantaneous squared values expressed in physical units.
- **PWR (Power)**: The power represents the average of a squared value. It is the unit used to determine the power at a given frequency for a determined (sinusoidal) signal. It is expressed in squared units

📖 *Refer to **paragraphs 11.3 and 11.4** for a detailed list of the frequency weightings and spectral units available in **dBFA**.*

The levels are calculated from international system units (SI). It is possible to modify the default values with the command **Preferences / Units' management.** See **paragraph 11.1**.

It is possible to display up to two signals on the same graphical view if the data items have the same characteristics (periods, duration).

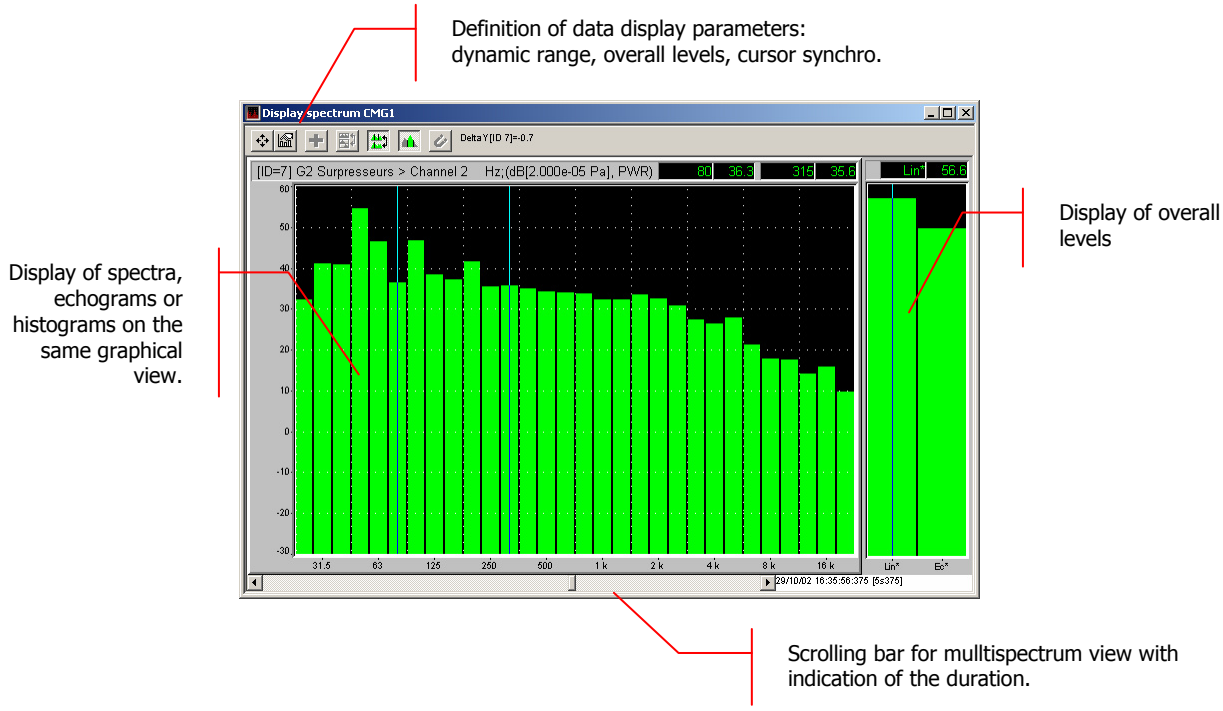


3.3.2. Broad band spectra and/or multispectra, Bark bands, histograms and echogram

This type of view is used to graphically display spectra and/or multispectra in broad bands (octaves, third octaves, and 1/Nth octaves), in Bark bands (psychoacoustic), as well as echograms and histograms.

For multispectra (a spectrum calculated for each integration step, defined by the user), a scrolling bar at the bottom of the view is shown in order to view the spectral quantity at different time periods.

An example of this type of view is given below:


Definition of data display parameters:
dynamic range, overall levels, cursor synchro.
Display spectrum CMG1
[ID=7] G2 Surpresseurs > Channel 2 Hz;(dB[2.000e-05 Pa], PWR)
Display of overall levels
Display of spectra, echograms or histograms on the same graphical view.
Scrolling bar for mulltispectrum view with indication of the duration.

The toolbar of the graphical view allows the user to perform the following operations:

Definition / Editing of data parameters for the graphical view

Curve layout

Activation / Deactivation of second cursor

Cursor synchronisation if several curves are displayed

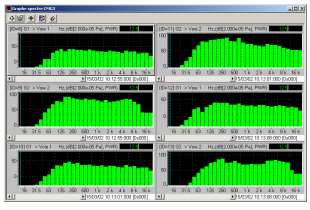
Definition / Editiing of display parameters for the graphical view

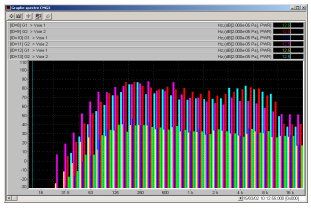
Go to stacked/superimposed mode if several curves with the same characteristics are displayed

Activation / Deactivation of Lin overall level display between cursors

The levels are calculated from international system units (IS). It is possible to modify the default values with the command **Preferences / Units' management.** See **paragraph 11.1**.

It is possible to display in a same window as many stacked curves as the system can handle, regardless of their characteristics. If the elements have the same units (Pa, m/s^2, …), curves can be superimposed.

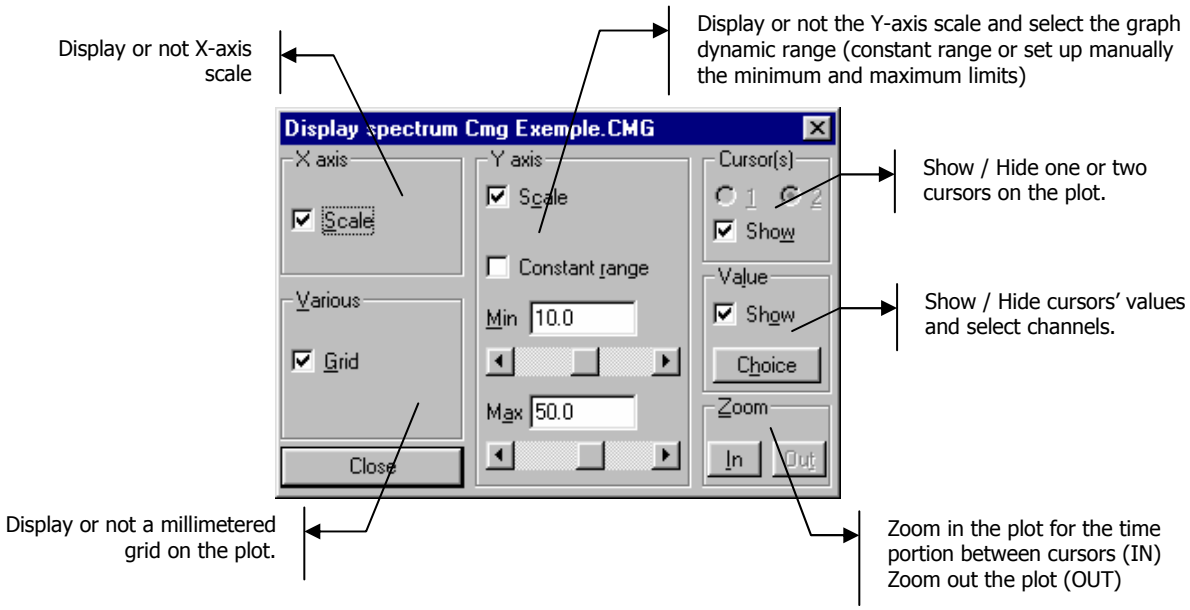

Stacked curves


Superimposed curves

3.3.2.1. Display parameters of the graphical view

Set-up the graphical display parameters using (**Plot / Plot set-up**).

The plot is updated immediately when a modification is made. Each plot has its own settings' dialog box: a modification on one plot does not affect the settings of another plot.



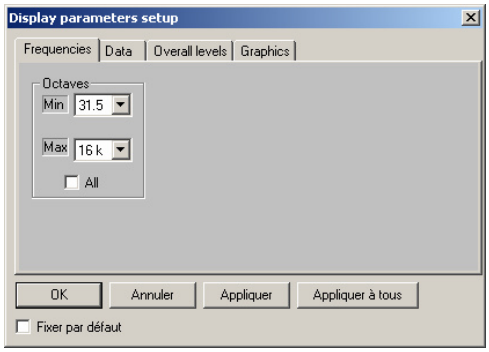
3.3.2.2. Data parameters for the graphical view

Define data parameters for the graphical view using (**Plot / Parameters**). The dialog box shown below appears on screen.

The tabs allow the user to define the following parameters.

To set default parameters, just check box and click on OK, Apply or Apply to all.

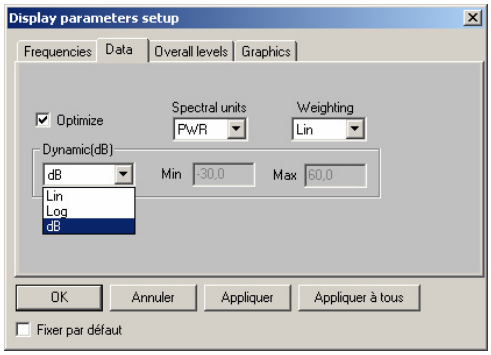
- **X axis (Frequency) tab**



In this tab, select the minimum and maximum frequency bands for spectrum display in the graphical view.

If the **All** box is ticked, the spectrum is displayed over the complete frequency range of acquisition.

- **Data tab**



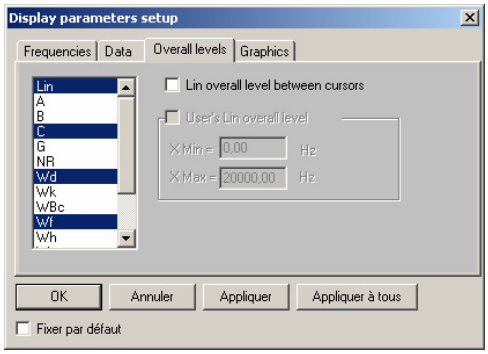
In this tab, select if the data should be displayed in physical units (**Dynamic: Lin or Log**) or in decibels (**dB**).

Then select the required spectral unit (**RMS** or **PWR** for broad band spectra and multispectra), as well as the frequency weighting to apply to the spectral data values.

If the **Optimise** box is not ticked, the user may then select the minimum and maximum values of the display dynamic range.

*Refer to **paragraphs 11.3 and 11.4** for a detailed list of the frequency weightings and spectral units available in **dBFA**.*

- **Overall levels tab (broad band spectra and multispectra)**



In this tab, and for broad-band spectra and multispectra only, select the overall levels to compute according to a given frequency weighting, displayed in a list.

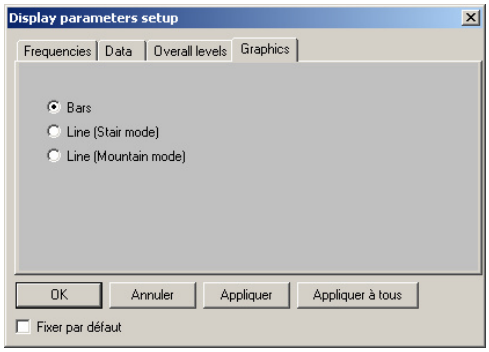
Overall levels are then displayed on the right handside of the spectrum view.

If two cursors are activated, it's possible to calculate a "Lin overall level between cursors" (noted Ec on the graph).

Overall levels are then displayed on the right hand side of the spectrum view.

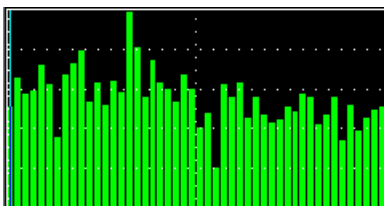
*Refer to **paragraphs 11.3** for a detailed list of the frequency weightings available in **dBFA**.*

- **Graphics tab**

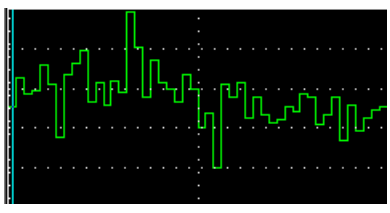


In this tab, select the type of graphics that will be displayed: line mode or bar mode.

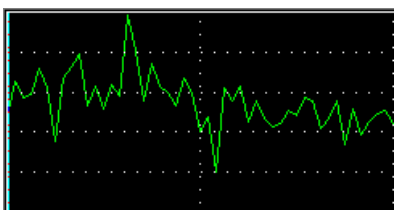
Examples of the different types of graphical representation are given below:



Bar mode



Line mode (stairs)



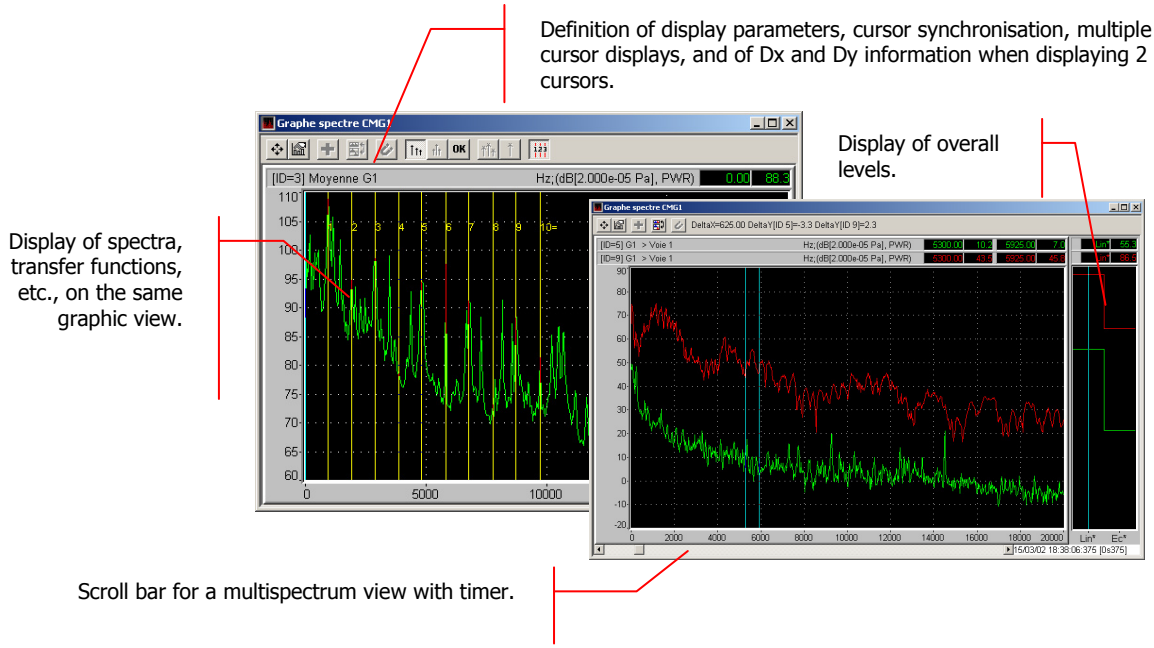
Line mode (mountain)

3.3.3. Narrow band spectra and/or multispectra, transfer functions and coherence

This type of view is used to graphically display autospectra and cross-spectra in narrow bands, with multispectrum capability, as well as transfer functions and coherence.

For multispectra (a spectrum calculated for each integration step, defined by the user), a scrolling bar at the bottom of the view is shown in order to view the spectral quantity at different time periods. Calculation of harmonic cursors and maxima is not possible on a multispectrum.

An example of this type of view is given below:


Definition of display parameters, cursor synchronisation, multiple cursor displays, and of Dx and Dy information when displaying 2 cursors.
Display of overall levels.
Display of spectra, transfer functions, etc., on the same graphic view.
Scroll bar for a multispectrum view with timer.

The toolbar of the graphical view allows the user to perform the following operations:

Definition / Editing of data parameters for the graphical view	Definition / Editing of display parameters for the graphical view
Curve layout	Go to stacked/superimposed mode if several curves with the same characteristics are displayed
Activation / Deactivation of second cursor	Activation / Deactivation of Lin overall level display between cursors
Cursor synchronisation if several curves are displayed	Display harmonic cursors (autospectrum only)
Display sideband cursors (autospectrum only)	Launch interpolation calculation on harmonic and sideband cursor table
Display maximum x values (autospectrum only)	Display maximum (autospectrum only)
Display identification labels for multiple cursors (autospectrum only)	

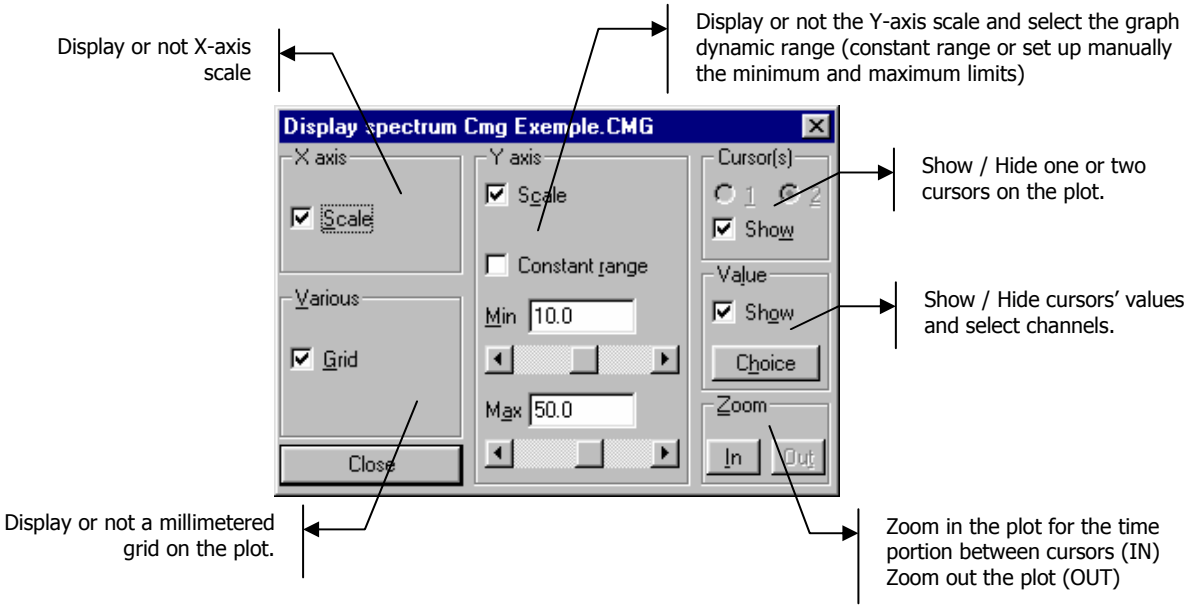
The levels are calculated from international system units (IS). It is possible to modify the default values using the command **Preferences / Units' management.** See **paragraph 11.1**.

It is possible to display in a same window as many stacked curves as the system can handle, regardless of their characteristics. As long as the elements have the same units (Pa, m/s^2, …), curves can be superimposed.

3.3.3.1. Display parameters of the graphical view

Set up the graphical display parameters with the command (**Plot / Plot set-up**).

The plot is updated immediately when a modification is made. Each plot has its own settings' dialog box: a modification on one plot does not affect the settings of another plot.



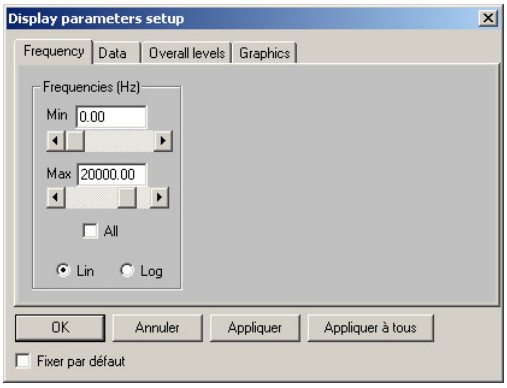
3.3.3.2. Data parameters for the graphical view

Define data parameters for the graphical view by the command (**Plot / Parameters**). The following dialog box appears on-screen.

To set default parameters, just check the box and click on OK, Apply or Apply to all.

The tabs allows the user to define the following parameters:

- **X axis (Frequency) tab**

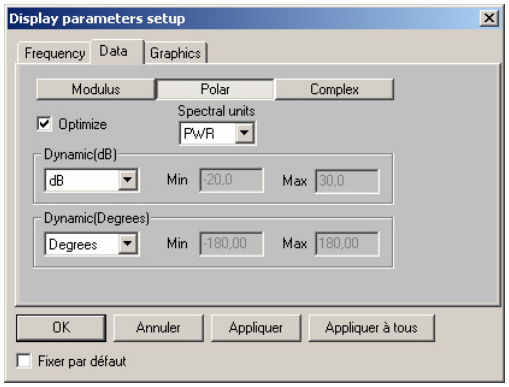


In this tab, select the minimum and maximum frequency bands for spectrum display in the graphical view

If the **All** box is ticked, the spectrum is displayed over the complete frequency range of acquisition.

Select a **Lin** scale or a **Log** scale for the frequency representation.

Data tab



In this tab, select if the data should be displayed in physical units (**Dynamic: Lin or Log**) or in decibels (**dB**).

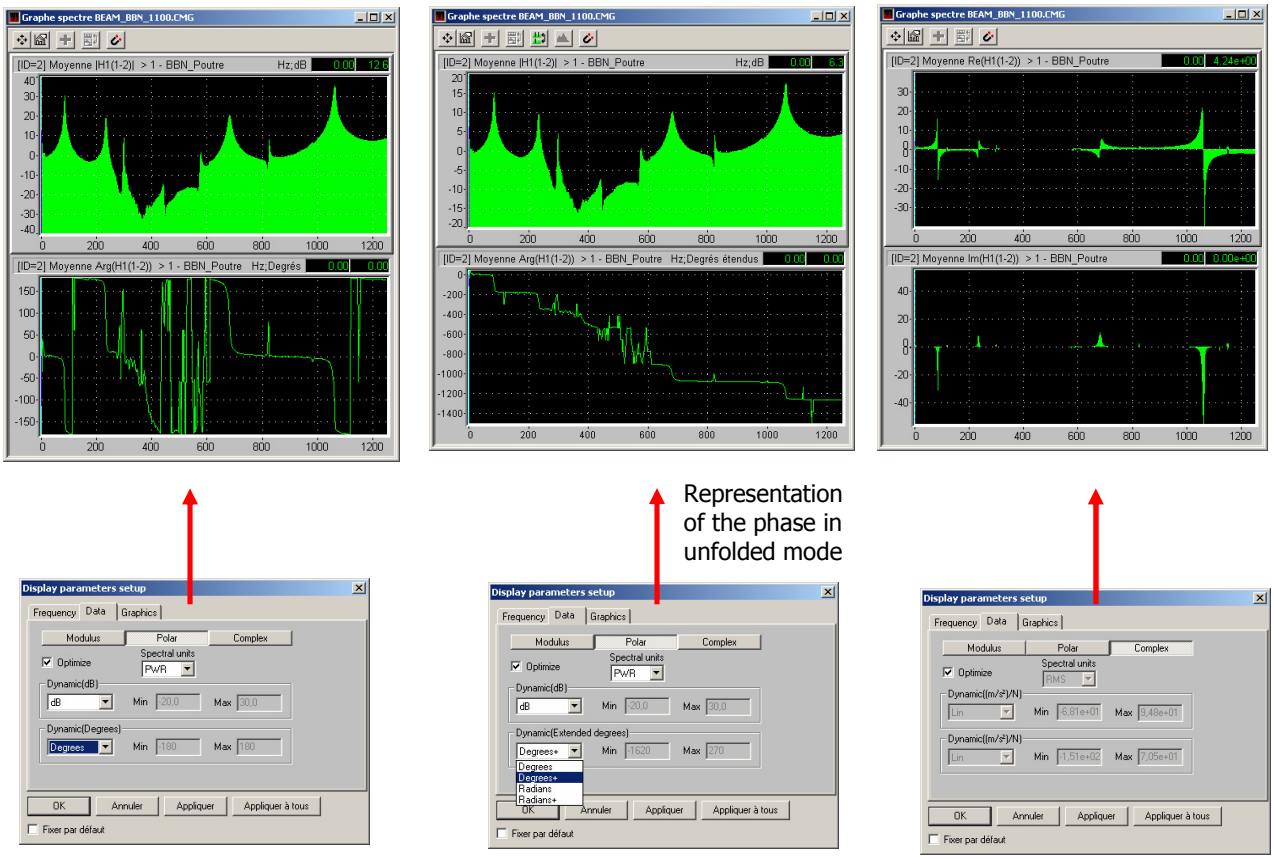
Then select the required spectral unit (**RMS, PWR, PSD, ASD or ESD** for narrow band spectra and **RMS, PWR, PSD or ASD** for multispectra) as well as frequency weighting to apply to the spectral data values.

If the **Optimise** box is not ticked, the user may then select the minimum and maximum values of the display dynamic range.

For cross-spectra and transfer functions, the user may display the data values in different manners: just the **modulus** (absolute value of the considered quantity), in **polar** form (modulus and phase) or in **complex** form (real and imaginary parts).

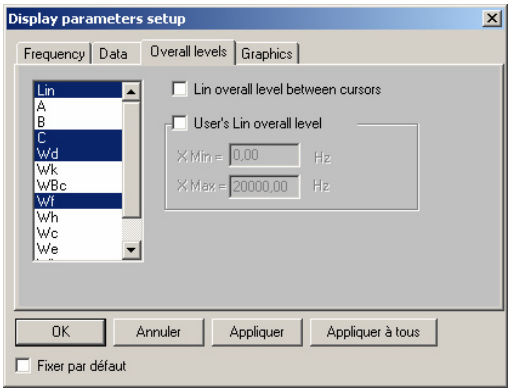
When displaying spectra in polar form, the phase can be represented as unfolded to have a clearer representation when the phase oscillates between +180 and –180°. To do so, select a dynamic range in **Degree+** or **Radian+**.

Different examples of these types of views are given below:


Graphe spectre BEAM_BBN_1100.CMG
[ID=2] Moyenne |H1(1-2)| > 1 - BBN_Poutre
[ID=2] Moyenne Arg(H1(1-2)) > 1 - BBN_Poutre
[ID=2] Moyenne Re(H1(1-2)) > 1 - BBN_Poutre
[ID=2] Moyenne Im(H1(1-2)) > 1 - BBN_Poutre
Representation of the phase in unfolded mode
Display parameters setup
Degrees
Degrees+
Radians
Radians+

*Refer to **paragraphs 11.3 and 11.4** for a detailed list of the frequency weightings and spectral units available in **dBFA**.*

- **Overall levels tab**



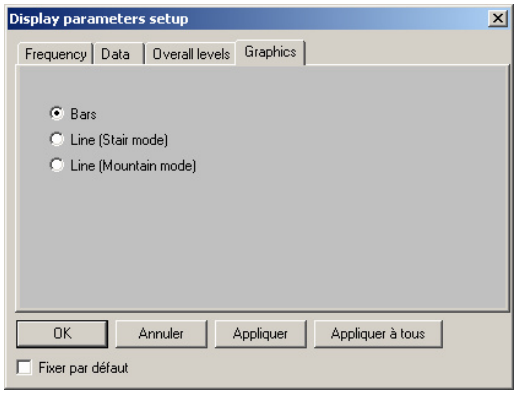
In this tab, select the overall levels to compute according to a given frequency weighting, displayed in a list.

It is possible to calculate and display a level between two fixed frequencies by checking the "User overall level" box and specifying a frequency range (labelled "U" on the curve).

If two cursors are activated, it is possible to calculate a "Lin overall level between cursors" (labelled "Ec" on the curve). To activate the second cursor, see Section 3.3.3.1.

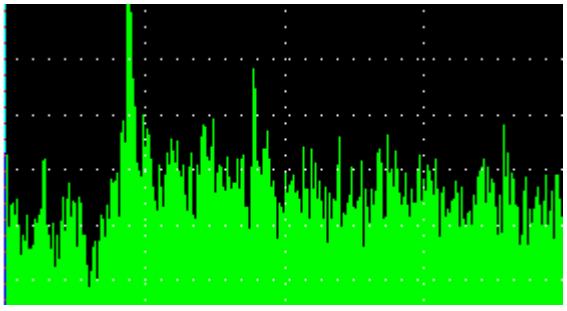
*Refer to **paragraphs 11.3** for a detailed list of the frequency weightings available in **dBFA**.*

- **Graphics tab**

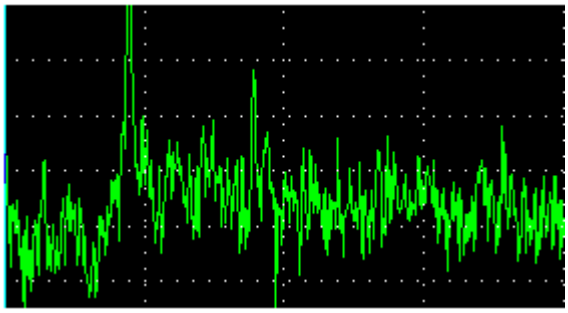


In this tab, select the type of graphics that will be displayed: line mode or bar mode.

Examples of the different types of graphical representation are given below:



Bar mode



Line mode (stair and mountains)

3.3.3.3. Using harmonic, sideband and maximum cursors

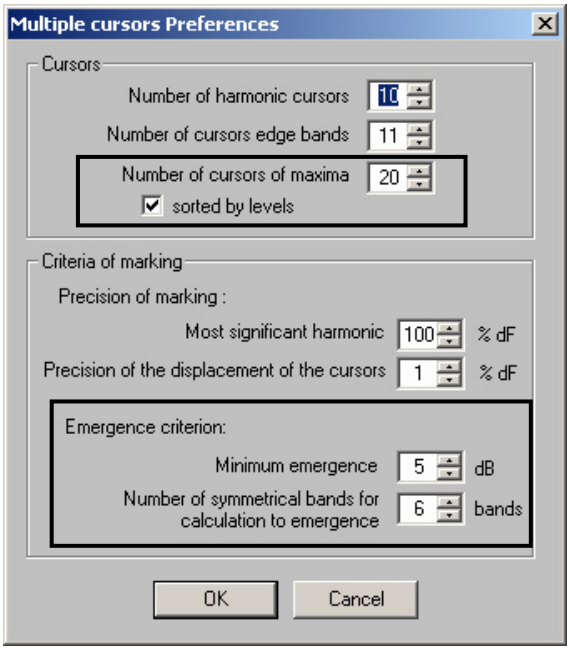
❑ Maximum cursors

Principle and operating mode

The aim of this operation is to detect lines resulting from the FFT calculations that stand out most, and then to get closer to the true value (Frequency + Level) of the physical phenomenon, using an interpolation calculation depending on the FFT weighting window and on the peak shape (since the exact value is never located exactly on a FFT calculation line).

Search parameters set-up

Use **Preferences / Multiple Cursors** to set parameters for maximum search. The dialog box below is then displayed:
Parameters pertaining to maximum cursors are circled.



- **Cursors**

Enter the number of cursors to search for and display.

For maximum cursors they may be sorted by level if the box "Sort by level" is checked. If this box is not checked, maxima will be sorted by increasing frequency.

- **Emergence criterion**

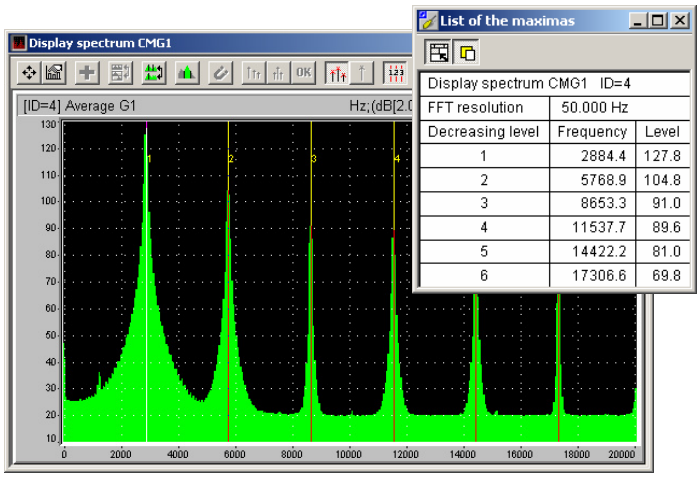
Set criteria for maximum detection.
Enter the minimum emergence with respect to the level of the two symmetrical neighbouring lines located X/2 lines on the left and X/2 lines on the right for a peak to be considered as a maximum, X being the "Number of symmetrical neighbouring lines…".

Example: If the "Number of symmetrical neighbouring lines" is set to 6 and the emergence to 5 dB, for a peak to be a maximum, its level must be greater by (or equal to) 5 dB than the two values located 3 lines before and 3 lines after.

These parameters are defined for all measurement sessions and do not need to be reset. They must however be adapted to the different types of spectrum encountered.

Launching maximum search and calculation of interpolated values

Open the plot of the spectrum to analyse, and launch the search for the maximum using the button, or use to launch the search for a defined number of maxima (number defined in the Preferences menu).


Display spectrum CMG1
[ID=4] Average G1
List of the maximas
Display spectrum CMG1 ID=4
FFT resolution 50.000 Hz
Decreasing level | Frequency | Level
1 | 2884.4 | 127.8
2 | 5768.9 | 104.8
3 | 8653.3 | 91.0
4 | 11537.7 | 89.6
5 | 14422.2 | 81.0
6 | 17306.6 | 69.8

If peaks meet the search criteria defined in the preferences, cursors will label the detected maxima on the plot and a table listing the results for the interpolation calculations will be displayed.

Use in the table to have it always in the foreground.

❑ Harmonic and sideband cursors

Principle and operating mode

In the case of harmonic cursors, the purpose is to find the fundamental frequency and the harmonics of a phenomenon, and then to get closer to the exact value of the said phenomenon using an interpolation calculation – depending on the FFT weighting window and on the peak shape (since the exact value is never located exactly on a FFT calculation line in the case of periodic phenomena). In the case of sideband cursors, the aim is to find the exact value of the main (carrier) frequency of a phenomenon, modulated in amplitude and/or in frequency by another phenomenon (side bands).

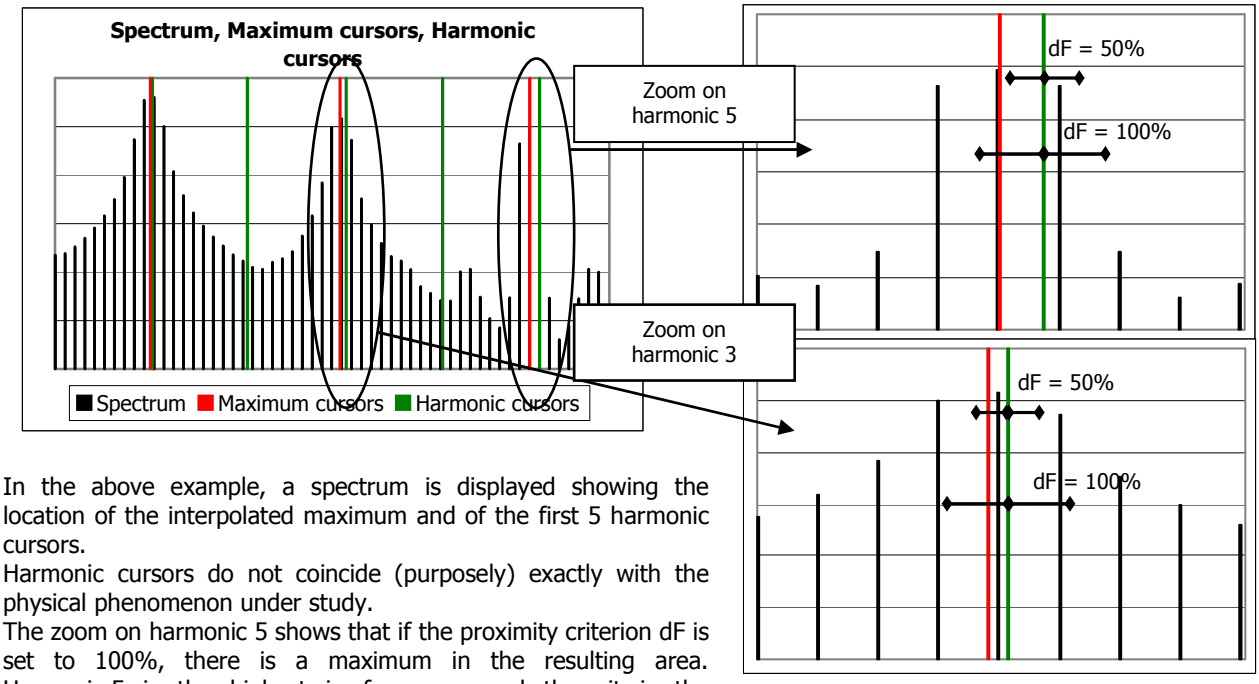
The following steps are required for the detection and the calculation of harmonics:

❶ **Spot** the **fundamental frequency** on the spectrum

❷ **Visually adjust** harmonic cursors with a displacement **step** in **percent** of the spectrum FFT **resolution**. Indeed, if the displacement of the fundamental frequency is carried out by steps of one (100%), then for the displacement of 1 FFT line, harmonic 10 moves by 10 FFT lines.

❸ For each cursor displacement, dBFA searches for a **significant harmonic**. The **significant harmonic** is that highest in frequency and closest to a maximum (see emergence criteria) within the limit set by the user in percent of the FFT resolution. This harmonic will be used as a reference for the **interpolation calculation**.

Precision on the detection of the significant harmonic and on the proximity criterion:



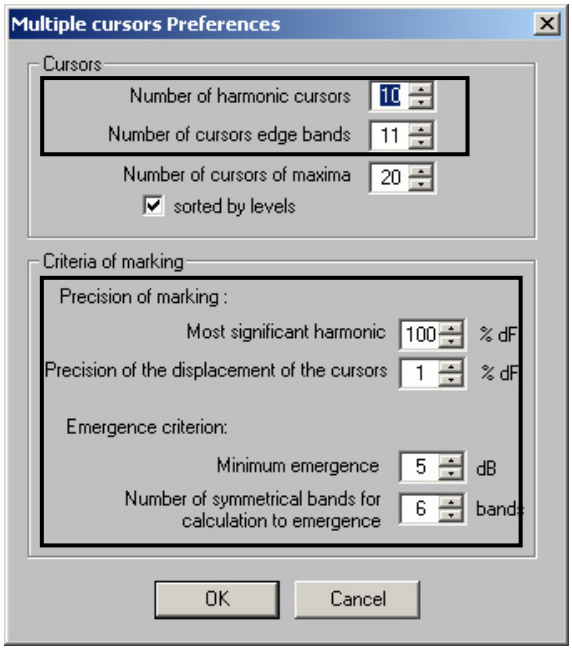
In the above example, a spectrum is displayed showing the location of the interpolated maximum and of the first 5 harmonic cursors.
Harmonic cursors do not coincide (purposely) exactly with the physical phenomenon under study.
The zoom on harmonic 5 shows that if the proximity criterion dF is set to 100%, there is a maximum in the resulting area. Harmonic 5 is the highest in frequency and thus it is the significant harmonic.
On the contrary, if dF is set to 50%, then the closest maximum to harmonic 5 does not belong to the defined area anymore.
Zoom on harmonic 3 shows then that if dF is set to 50%, there is a maximum located in the defined area. Harmonic 3 will then be the significant harmonic since it is the highest frequency meeting the proximity criterion.

❹ If there is a **significant harmonic** then the **interpolation** calculation can be launched.
The frequency and the level of the significant harmonic are interpolated, then for each harmonic the level is interpolated from the cursor position. The frequency is calculated according to the significant harmonic using the rule of 3 (for the frequency calculation there can actually be an interaction between the window effect and the position of the significant harmonic).

❺ If no harmonic meets the emergence and proximity criteria, one can "force" a harmonic by double clicking on the cursor of the chosen harmonic. The interpolation calculation can then be launched based on the selected harmonic.

Search parameters set-up

Use **Preferences / Multiple Cursors** to set parameters for harmonic search. The dialog box below is then displayed.
Parameters pertaining to harmonic and sideband cursors are circled.



- **Cursors**

Enter the number of cursors to calculate and display.
The number of sideband cursors is always odd given that we are searching for frequencies (side bands) around a centre frequency (carrier).

- **Marking criteria**

The **"Most significant harmonic"** parameter is used to set the tolerance between the position of the most significant harmonic and a maximum.

The **"Precision for cursor displacement"** parameter is used to define the displacement step for the cursor placed on the fundamental frequency.

The **"Emergence criteria"** parameters are used to set parameters for the detection of maxima.
Enter the minimum emergence with respect to the level of the two symmetrical neighbouring lines located at X/2 lines on the left and X/2 lines on the right, X being the "Number of symmetrical neighbouring lines…".

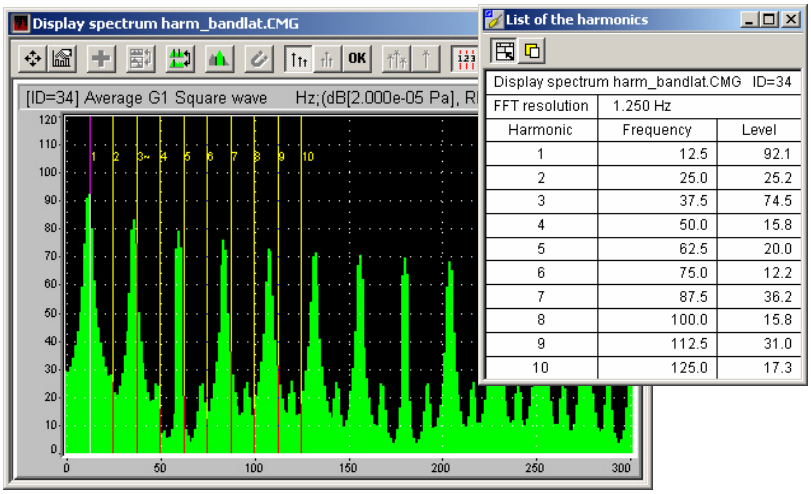
These parameters are defined for all measurement sessions and do not need to be reset. They should however be adapted to the different types of spectra encountered.

Launching harmonic search and calculation of interpolated values

Open the plot of the spectrum to analyse and follow the steps described hereafter:

❶ Place the cursor on the fundamental frequency.

❷ Press to display harmonic cursors and a table of values corresponding to the FFT lines.


Display spectrum harm_bandlat.CMG
[ID=34] Average G1 Square wave
List of the harmonics
Display spectrum harm_bandlat.CMG ID=34
FFT resolution 1.250 Hz
Harmonic | Frequency | Level
1 | 12.5 | 92.1
2 | 25.0 | 25.2
3 | 37.5 | 74.5
4 | 50.0 | 15.8
5 | 62.5 | 20.0
6 | 75.0 | 12.2
7 | 87.5 | 36.2
8 | 100.0 | 15.8
9 | 112.5 | 31.0
10 | 125.0 | 17.3

Use to have the table always displayed in the foreground.

❸ Click on the graphics window to make it active and move the harmonic cursors using the CTRL and arrow keys so that they correspond **visually** to the harmonics. If a significant harmonic is found, it will be labelled with a "=" sign if it is exactly on the FFT line or with a "~" sign otherwise.

❹ Click on

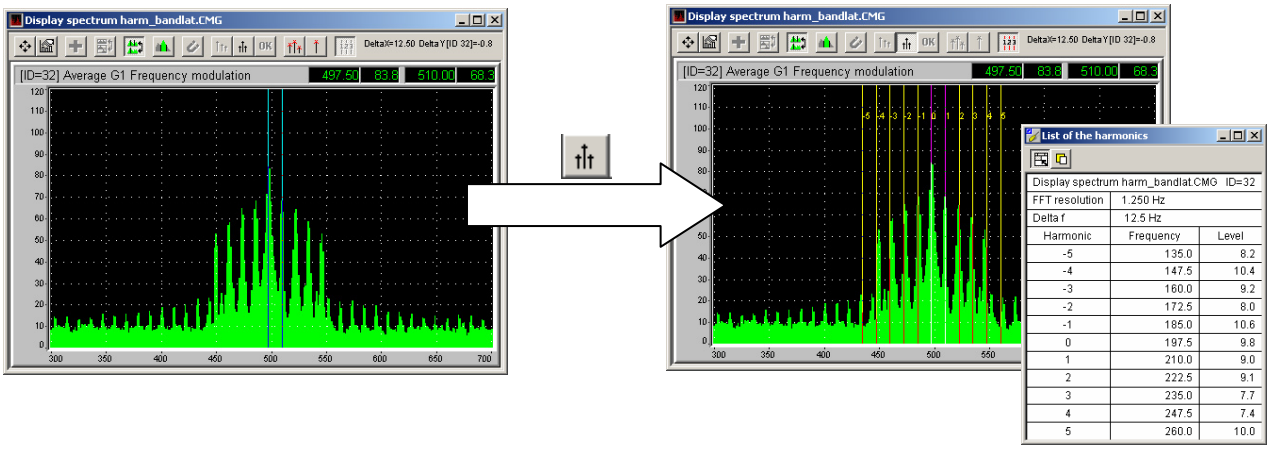
to launch the interpolation calculation and obtain calculated values that are closer to the physical phenomenon.

If the

button is disabled, it means that no line corresponds to the emergence and tolerance criteria. It is then necessary to better adjust the search parameters.
It is also possible to impose a significant harmonic by double clicking on the cursor of the corresponding harmonic. In this case, an "X" will be displayed next to the harmonic.

Sideband cursor

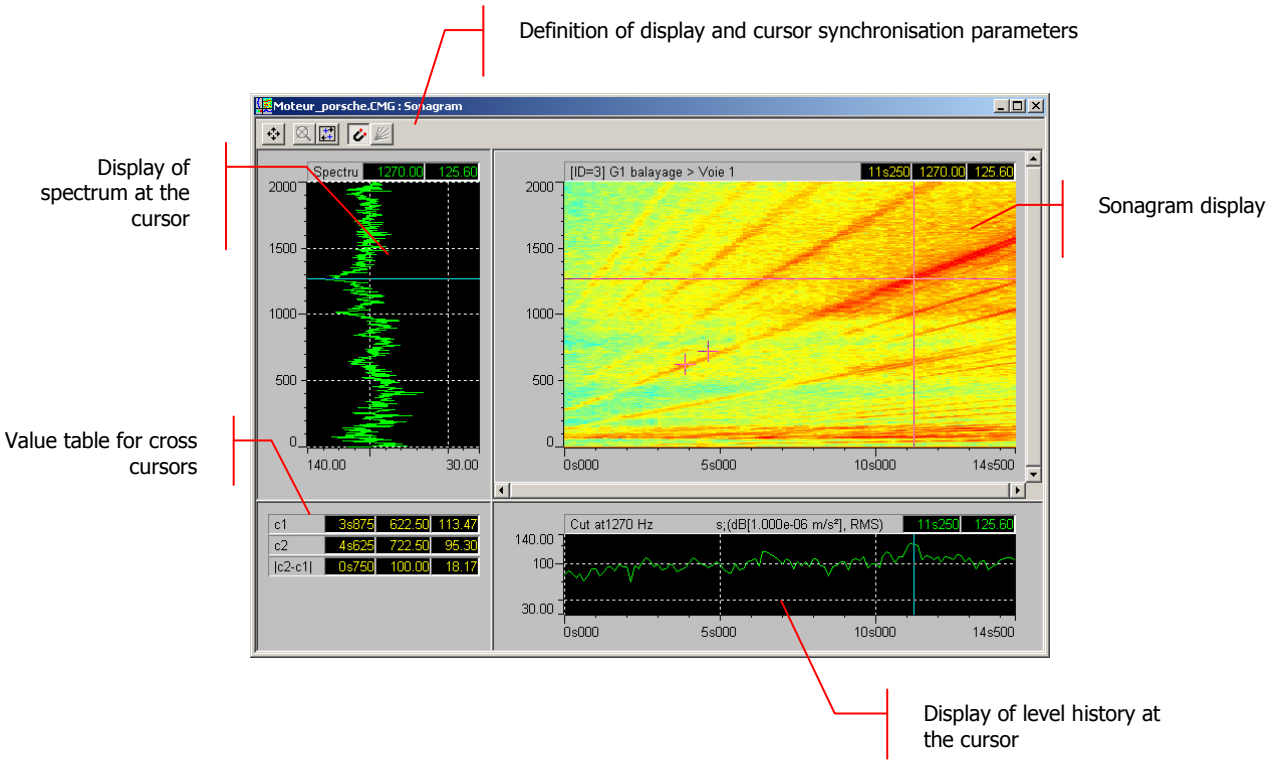
For sideband cursors, the principle and the stages are the same, but a second cursor needs to be activated (see Section 13.3.3.1).
Place a cursor on the fundamental frequency and then the second cursor on the next greater side band (right of the fundamental frequency).



3.3.4. Sonagram view

This type of view displays all narrow-band autospectra, with timing or other mode (depending on the speed…). To view the sonagram, first select the item and then use the **Session / Sonagram** menu.

An example of a sonagram view is shown below:


Definition of display and cursor synchronisation parameters
Display of spectrum at the cursor
Sonagram display
Value table for cross cursors
Display of level history at the cursor
Moteur_porsche.CMG : Sonagram
Spectru 1270.00 125.60
[ID=3] G1 balayage > Voie 1
11s250 1270.00 125.60
c1 3s875 622.50 113.47
c2 4s625 722.50 95.30
|c2-c1| 0s750 100.00 18.17
Cut at1270 Hz
s;(dB[1.000e-06 m/s²], RMS)
11s250 125.60

The toolbar of the graphic view gives access to the following operations:

Define / Edit data parameters for display	Cancel zoom – Zoom function is accessible by pressing on the Shift key and selecting the area with the mouse
Place cross cursors in sonagram corners (bottom left and top right)	Cursor synchronisation between the three views (spectrum, time history and sonagram)
Activate or deactivate order cursor	

Levels (in dB) are calculated with respect to the international system reference values. Reference values can be modified, as well as the physical units, using the **Preferences / Units' management** menu. See **Section 11**.

3.3.4.1. Section Cursor

The displacement of the cut cursors updates directly the section views.

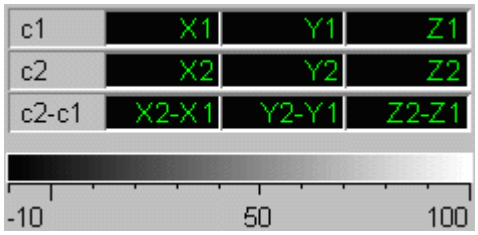
Generally:

- ✓ The vertical cut corresponds to the spectrum for the time axis of the vertical cursor.
- ✓ The horizontal cut corresponds to the signal time history (or RPM) for the frequency axis of the horizontal cursor.

The user can change the time and frequency axis (see Preferences / Sonagram).

3.3.4.2. Differential cursors

The differential cursors allow the user to differentiate the X, Y, Z co-ordinates on exact two points of the sonagram.



Initially these points are situated in the lower left corner (point c1) and the upper right corner (point c2) of the sonagram.

The co-ordinates of these two points and the algebraic difference of the values of each axis (see on the opposite) are displayed at the bottom on the left of the window.

3.3.4.3. Color scale

The color scale according to the amplitude is displayed at the left bottom of the window.

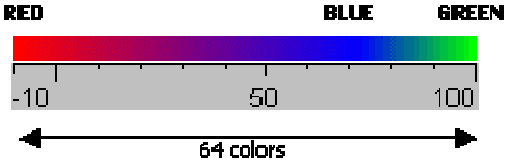
The user can change the colors using the graphic settings box as well as customize personal colors.

User-defined color palette

The user can define a color palette for the display of the sonagram with a text file named **User.rgb** that should be situated in the program directory.
The standard directory to install 01dB-Metravib software is *C:|Program Files|01dB-Metravib.*
This file describes the maximum number of colours that are available for the display of the sonogram and gives an exact colour for certain levels.
The colours are defined with the RGB code (red, greed, blue), expressed in decimal numbers.

Example of a User.rgb file:

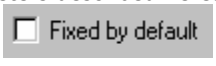
NB_MAX_COLOR=64	64 colours palette
0=255,0,0	
75=0,0,255	75% Interpolation of 64 colours between red and blue
100=0,255,0	25% Interpolation of 64 colours between blue and green



3.3.4.4. Data calculation parameters for display

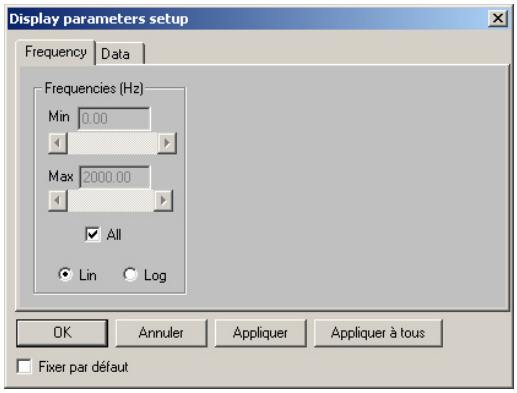
Use or **Sonagram / Parameters** to set calculation parameters. A dialog box including several tabs is displayed on screen.

These tabs are used to define the parameters described hereafter.

To set the default parameters, check the 

box and click on OK, Apply or Apply to all.

- **"Frequencies" tab**

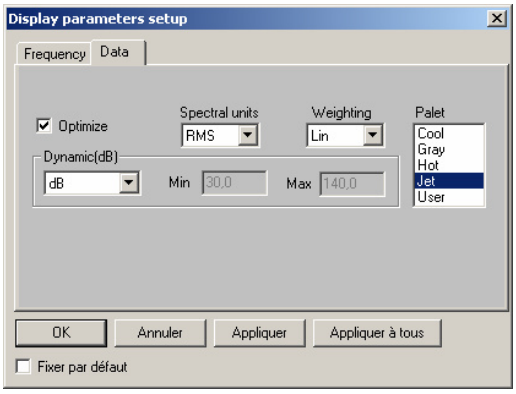


Select the minimum and maximum frequency bands to be displayed on the graphic view.

Check the **All** box to view data over the acquisition frequency range.

Select a **Lin** scale or a **Log** scale for the frequency representation.

- **"Data" tab**



Select physical units (**Dynamic: Lin or Log**) or decibels (**dB**) for data display.

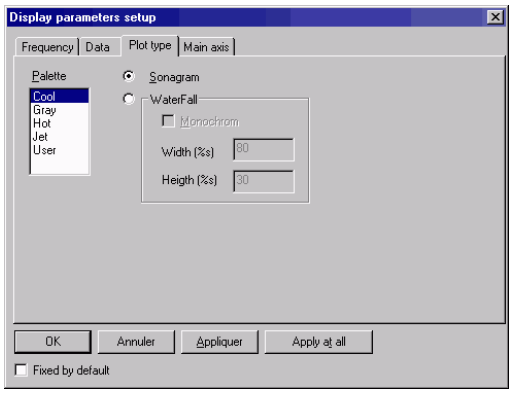
Select the spectral unit (**RMS** or **PWR** for broad band spectra and multispectra, **RMS, PWR, ASD** or **PSD** for narrow band spectra and multispectra), as well as the weighting to apply to all spectral data.

Select the weighting to apply to the spectrum (Lin, A, B…).

If the **Optimise** box is not checked, then minimum and maximum values of the display dynamic range can be set here.

*Refer to Sections 11.3 and 11.4 for a detailed list of frequency weightings and types of spectral units available in **dBFA**.*

- **"Plot type" tab**



Choose in the Plot type tab:

- ✓ The color palette to display the amplitudes (see also user palette)
- ✓ Sonogram or waterfall display

- **"Main axis" tab**

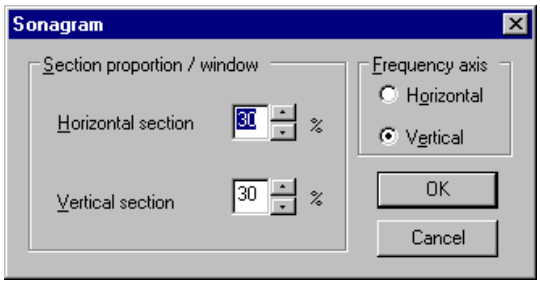
Select in the Main axis tab the the beginning and the end to display, the "Reinit" button allows to display the entire recording.

3.3.4.5. Zoom

One can display a detailed part of the sonogram by enlarging the whole view. Therefore you have to maintain the SHIFT key of the keyboard and define the rectangle to be enlarged with the mouse pointer by keeping the button pressed.

3.3.4.6. Sonagram preferences

The menu **Preferences / Sonagram** is used to access the additional settings concerning the sonagram display.



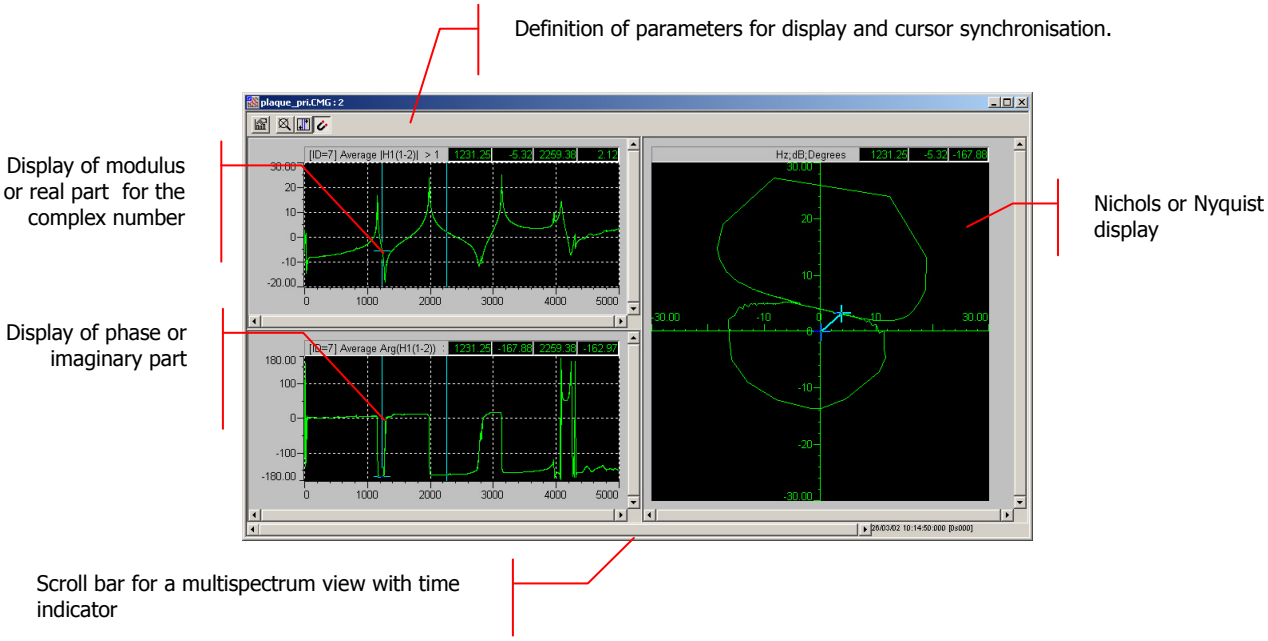
- The size of the section display in relation to the sonagram view is defined in percentage.
- The user can also define horizontal or vertical display of the time axis.

Validate the modifications by OK. The changes are taken into account directly on the open windows of the sonagram.

3.3.5. Nichols / Nyquist views

This type of view is used to display all narrow band transfer functions and cross spectra with or without timing. To view the Nichols or the Nyquist diagram, select the item and go to **Sessions / Nichols/Nyquist**.

The figure below shows an example of Nichols / Nyquist view:


Definition of parameters for display and cursor synchronisation.
Display of modulus or real part for the complex number
Display of phase or imaginary part
Nichols or Nyquist display
Scroll bar for a multispectrum view with time indicator

The toolbar in the graphic window fives access to the following operations:

Define / Edit data parameters for display	Cancel zoom – Zoom function is accessible by pressing on the Shift key and selecting the area with the mouse
Place cross cursors in corners	Cursor synchronisation for the selection of a specific working area

Levels (in dB) are calculated with respect to the international system reference values. Reference values can be modified, as well as the physical units, using the **Preferences / Units' management** menu. See **Section 11.1**.

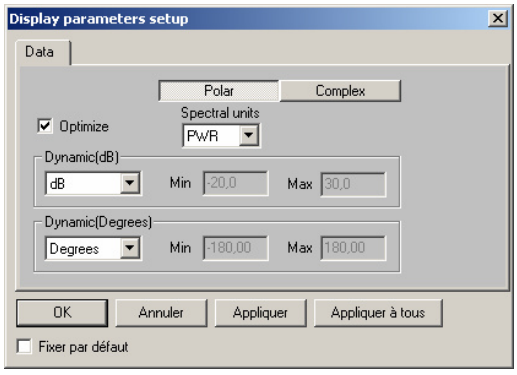
3.3.5.1. Data calculation parameters for display

Use or **Nyquist/Nichols / Parameters** to set calculation parameters. A dialog box including several tabs is displayed on screen.

These tabs are used to define the parameters described hereafter.

To set the default parameters, check the Fixed by default box and click on OK, Apply or Apply to all.

- **"Data" tab**



Select the appropriate representation; the polar view corresponds to the Nichols representation, and the complex view to the Nyquist representation.

Select physical units (**Dynamic: Lin or Log**) or decibels (**dB**) for data display.

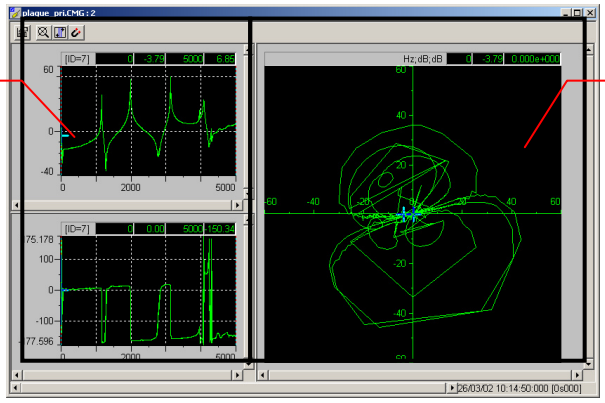
Select the spectral unit (**RMS** or **PWR** for broad-band spectra and multispectra), as well as the weighting to apply to all spectral data.

If the **Optimise** box is not checked, then minimum and maximum values of the display dynamic range can be set here.

*Refer to Sections 11.3 and 11.4 for a detailed list of frequency weightings and types of spectral units available in **dBFA**.*

In this view, the parameters for the modulus/phase or real/imaginary complex views are dissociated from the Nichols or Nyquist views. It is then possible that both the Modulus/phase view and the Nyquist view are displayed at the same time. To avoid this, click on the "Apply to all" button so that the transition from Nichols to Nyquist is applied to both views. Otherwise, remember to apply the same parameters on both views.

Modulus + phase view or real + imaginary complex view



Nichols or Nyquist view

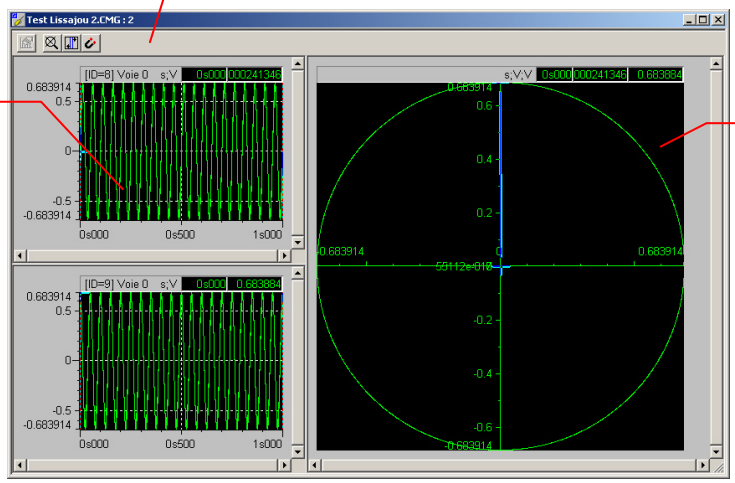
3.3.6. *Lissajous view*

This type of view displays the Lissajous representation between two signals. To view the Lissajous representation, select two Signal items and go to **Datafile / Lissajous**.

An example is shown below:

Definition of parameters for display and cursor synchronisation

Signal display for both channels



Lissajous display

The toolbar in the graphic window is used to perform the following operations:

Define / Edit data parameters for display

Place cross cursors in corners

Cancel zoom – Zoom function is accessible by pressing on the Shift key and selecting the area with the mouse

Cursor synchronisation for the selection of a specific working area

Levels (in dB) are calculated with respect to the international system reference values. Reference values can be modified, as well as the physical units, using the **Preferences / Units' management** menu. See **Section 11.1**.

3.4. Listings of data items (tables)

Use the command **Datafile / List**, after selection of one or more data items in the list, in order to display data items as a table of results. The user can also double click on the items of interest to display the table of results.

The following types of data items may be displayed as a table in the application **dBFA**:

- Broad-band spectra
- Stationary psychoacoustic criteria

Examples of tables of results are given below:

psy.cmg : Listing

D:\01dB\01dB programs 32bit\databin\psy.cmg	
ID	26
Family	Autospectrum
Data type	Leq
Date	22/07/97 01:53:22
1st channel location	Point 1
Duration	
Channel(s)	1
Hz	(dB [Ref 2.00e-05 Pa], PWR)
100	63,0
125	61,6
160	62,4
200	64,3
250	63,7
315	63,4
400	62,4
500	63,9
630	63,4
800	63,5
1 k	62,7
1.25 k	61,2
1.6 k	61,0
2 k	61,3
2.5 k	58,5
A	71,8
Lin	75,1

Table of results for broad band spectra

Psychoacoustic : 6 (psy.cmg)

Loudness	27.57	sone (F)
Sharpness	1.04	acum (F)
Fluctuation Strength	1.09	vacil (F)
Tonality	0.00	tu (F)
Roughness	8.34	asper
Unbiased Annoyance	258.03	au (FD)
Sensory Pleasing Sound	0.00	pu (F)
Loudness 10%	56.85	sone (F)
Articulation Index (NHV)	41.17	%
Articulation Index (Unikeller)	41.15	%
Articulation Index (Rooms)	57.00	%

Table of results for psychoacoustic criteria

The toolbar of the table of results allows the user to perform the following operations:

Definition / Editing of data parameters for the table of results

Automatically adjust the window size to the table size

The levels are calculated from international system units (IS). It is possible to modify the default values with the command **Preferences / Units' management.** See **paragraph 11.1**.

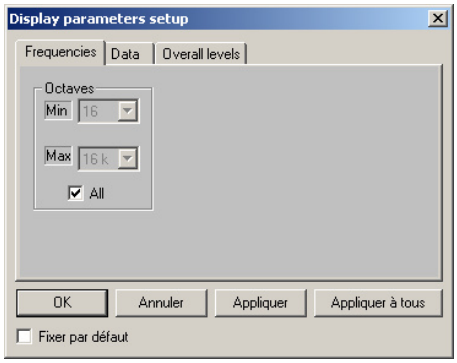
3.4.1.1. Data parameters for the table of results

Define data parameters for the table of results using the command (**Listing / Parameters**). The following dialog box appears on-screen. This command only applies to broad-band spectra. The tabs within this dialog box are used to define the following parameters:

To set the default parameters, check the

box and click on OK, Apply or Apply to all.

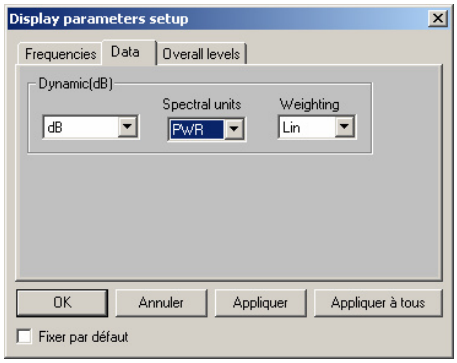
- **X axis (Frequencies) tab**



In this tab, select the minimum and maximum frequency bands for spectrum data values in the table of results.

If the **All** box is ticked, the spectrum values are listed over the complete frequency range of acquisition.

- **Data tab**

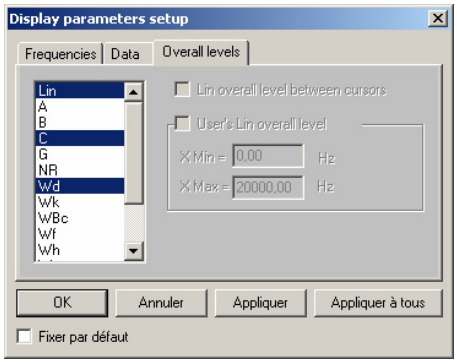


In this tab, select if the data should be listed in physical units (**Dynamic: Lin or Log**) or in decibels (**dB**).

Then select the required spectral unit (**RMS** or **PWR** for broad-band spectra), as well as frequency weighting to apply to the spectral data values.

*Refer to **paragraphs 11.3 and 11.4** for a detailed list of the frequency weightings and spectral units available in **dBFA**.*

- **Overall levels tab**



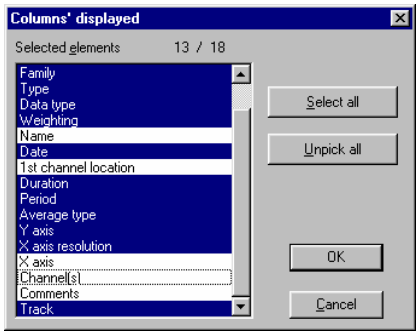
In this tab, select the overall levels to compute according to a given frequency weighting, displayed in a list.

Overall levels are then displayed at the bottom of the table of results.

*Refer to **paragraphs 11.3** for a detailed list of the frequency weightings available in **dBFA**.*

3.5. Description and selection of columns in a measurement session window

Use the command **Datafile / Columns** to select the columns that will be displayed in the main window of a measurement session data file. The dialog box shown below appears on screen.



Select with the mouse the different column fields that will be displayed in the main window of a measurement session data file.

The key **Select all** allows the user to select all possible columns fields while the key **Unpick all** allows the user to clear all the column fields.

The table below gives the meaning of column available in a measurement session window:

Columns	Meaning
Selection (Sel.)	When selecting several data items in the measurement session window, a number is shown in this column that displays the selection order of the data items.
ID	Identifier of the data item. A number. This number is incremented (from 0) each time a data item is added to the measurement session.
Family	Set of data items of the same family: audio, autospectra, transfer functions, etc.
Type	Type of a given spectrum (emitted noise, received noise, etc. for building acoustics)
Data type	Type of quantity allowing us to define more accurately the data item (for a Fast sound pressure level, the family would be Leq and the data type will be Fast)
Weighting	Frequency weighting applied to the data item during acquisition or off-line analysis: A, B, C, Lin weightings, vibration weightings, etc.
Name	Name of the analysis that created this data item. It is the name of the operator for an off-line analysis and the name of the acquired quantity for a real-time measurement.
Date	Date and time of the data item, corresponding to the date of creation or modification
Location	Location defined during acquisition (Channel 1 by default). For cross spectra, it corresponds to the location of the first measurement channel.
Duration	Duration of the data item (hour / minutes / seconds)
Period	Base duration or integration time of data items that vary with time.
Average type	Type of averaging method used to compute the data item (average, min., max., statistical)
Average duration	Duration of the averaging for the element calculation
Y axis	Physical unit (or dB for the histograms) of the Y axis
X axis resolution	Resolution of the X axis (in seconds for time histories of data items, frequency resolution for spectrum data items)
X min	Minimum frequency value
X max	Maximum frequency value
X axis	Unit of the X axis (Hz, seconds, %, etc.)
Channel(s)	Number of the measurement channel on which the data item has been acquired
Information	Information on the element
Comments	Comments of the data item, from measurement set-up or item modification
Track	For off-line analysis, this field indicates how this data item was computed : ID of the original data item, name and type of operators used to compute the result)
Source file	Name of file imported to dBFA
Format	Name of the format : INT, UINT, FLOAT...

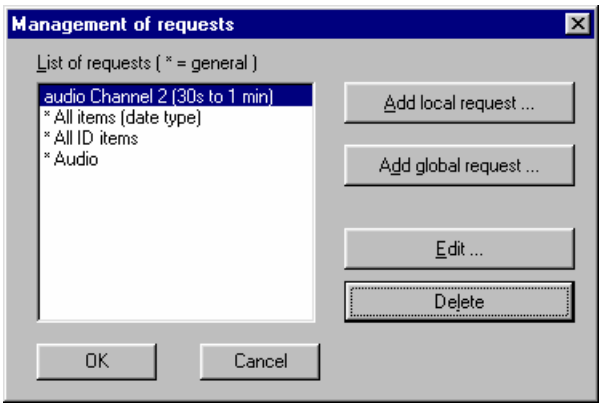
3.6. Editing and running requests (data sorting)

Measurement session datafiles have a structure similar to databases. As any measurement result is stored into these datafiles, a set of requests functions allow the user to sort the data according to various parameters.

One can display, for example, data items of the same family only (audio events, narrow-band spectra, octaves and third octave spectra, etc.) in the measurement session view.

3.6.1. Overview of requests' editing

Use the command **Datafile Edition of requests** to open the dialog box that allows the user to define, edit or remove requests.



dBFA manages two types of requests: **local requests**, which apply only to the active measurement session, and **global requests**, which apply to any measurement session. Global requests are preceded by an asterisk (*).

The procedure to define a request is the same in both cases.

Click on "Add local request…" to add a new local request to the active measurement session and click on "Add global request…" to add a new global request for any measurement session that will be opened in the application software.

Click on **Edit** to modify an existing request selected in the list and click on **Remove** to remove an existing request from the list.

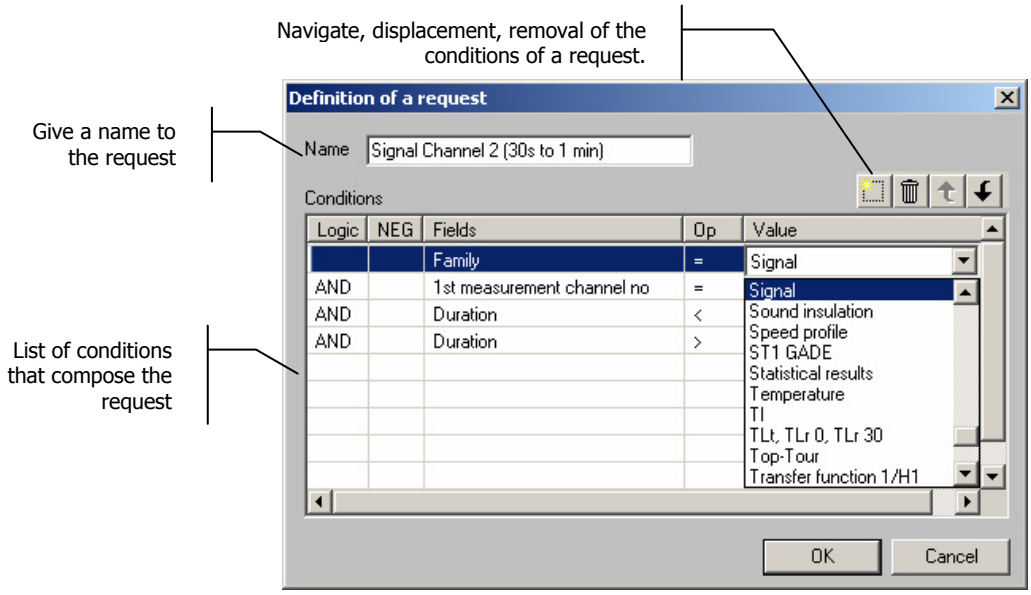
By default, only one type of general request is defined in **dBFA**:

- *** All items**
  Sort data items of a measurement session

3.6.2. Add or modify a request (local or global)

3.6.2.1. Overview

Access the dialog box shown below when creating a new request or editing an existing request.



After definition of the request name (that will appear in the list of requests), define one or several conditions that compose the request. The columns of the list of conditions of a request allows the user to define the following parameters:

- **Logic column**
  Define a Boolean operator (**AND/OR**) when several conditions have been defined. The data items will be displayed when all the conditions of the request are verified (**operators AND**) or at least one condition is verified (**operators OR**).

- **NEG column (negative)**
  If this case is activated, the data items that will be displayed are the items that do not correspond to the condition.

- **Fields column**
  Select the quantity according to which the data items will be sorted. A list proposes all the fields that characterise data items (family, name, ID, duration, etc.)

- **Op column (operation)**
  Equality, inequality of the quantity selected in the Fields column.

- **Value column**
  Value that takes the quantity selected in the Fields column. The operation of the Op column forms the condition of the request.

Furthermore, a tool bar allows the user to perform the following operations:

Insert a condition in the list at the current mouse location

Remove the condition selected in the list

Move up the condition selected in the list (appears in video inverse)

Move down the condition selected (highlighted) in the list

The definition order of the conditions is important: indeed, the Boolean operator (logic column) of the last condition defined is applied to all the conditions that precede it.

For example, for a set of conditions to verify simultaneously (AND operator in between each condition), if the operator for the last condition is OR, then the request will display data items that match all the conditions associated by the AND operator, as well as the data items that match the last condition.

The example below illustrates the principle:

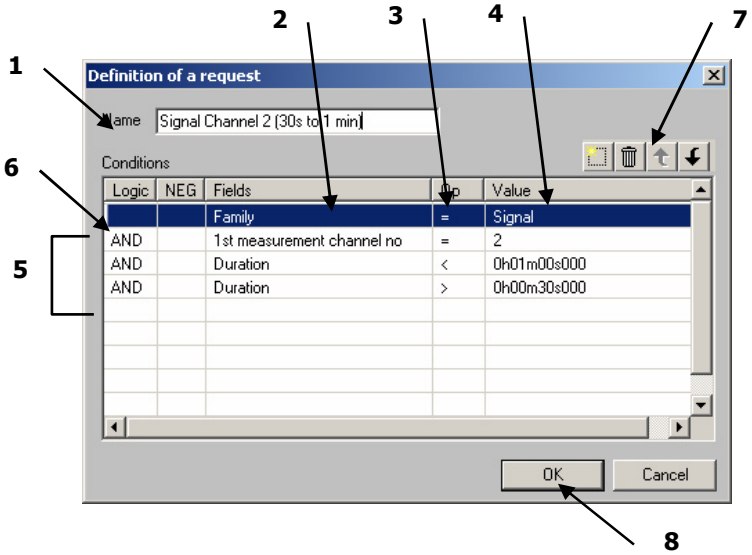
Logic	NEG	Fields	Op	Value	Logic	NEG	Fields	Op	Value
		Family	=	Signal			Family	=	Signal
AND		Duration	<	0h01m00s000	AND		Duration	<	0h01m00s000
AND		Duration	>	0h00m30s000	OR		Duration	>	0h00m30s000

Data items of the Signal family and of duration ranging from 30 seconds to 1 minute will be displayed.

Data items of the Signal family and of duration greater than 30 seconds will be displayed, as well as data items (whatever the family) of duration less than 1 minute.

3.6.2.2. Definition principle

Follow the instructions below to add a new request:



1. Give a **name** to the current request. This name will appear in the list of requests in the management dialog box.
2. On the first line of the conditions' list, click on the **Fields** column and select the desired quantity in the scrolling list.
3. On the same line, click on the **Op** column and select the equality value in the scrolling list.
4. On the same line, click on the **Value** column and select a value in a scrolling list or input it manually.
5. Repeat steps 2 to 4 for each condition to define.
6. Select the Boolean operators in the Logic column to define interactions in between the conditions.
7. Define the order of the request conditions, remove a condition if necessary.
8. Validate the request.

3.6.2.3. List of the values available to define a request

Here is a complete table of the different choices available when defining a request.

Fields column	Description (Fields column)	Op column	Value column
1/n octave	Frequency resolution of a broad band spectrum or multispectrum	< ; <= ; <> ; = ; > ; >=	n = 1, 3, 6, 12, 24, 48
Application	Name of the application software used to create the item	@, =	Manual input
Building calculation	Results generated from building calculations (airborne isolation, shock noise…)	= ; <>	Alpha p / Alpha w; Alpha s; D (French standard); D (ISO standard); Dn,w; Dn,T / Dn,T,W; DnT / DnAT pink, DnT / DnAT route; Unknown; Ln / Ln,w; L'n / L'n,w; LnT / LnAT; L'nT / L'nT,w; R / Rw; R' / R'w
Comments	User comments on the item	@, =	Manual input
Date	Date of creation of the item	< ; <= ; <> ; = ; > ; >=	Manual input (day/month/year hh:mm:ss). 01/02/1999 16:42:05
Duration	Duration of an item	< ; <= ; <> ; = ; > ; >=	Manual input (ddd/hh/mm/ss/ms) 30 seconds : 000j00h00m30s000
Family	Set of data items of the same family: signal, autospectra, transfer functions, etc.	= ; <>	attack decay sustain release, signal, autospectrum, clarity, code, coherence, comment, counter, room criteria, EDT, transfer functions (1/H1, H1, 1/H2, H2), histogram (%, Nb), cumulated histogram (%, Nb), Intensity (active, reactive, free field), cross-spectrum, sound insulation, Leq, measurement, mean pressure, psycho, RASTI, impulse response, sensitivity, Bark spectrum, scalar spectrum, STI, TI, TR
Source file	Name of file imported to dBFA	@ ; =	Manual input
Format	Name of the format	= ; <>	_double, _float, _int16, _int24, _int32, _int64, _int8, _uint16, _uint32, _uint64, _uitn8, Bits
Data type	Type of quantity allowing us to define more accurately the data item (for a Fast sound pressure level, the family would be Leq and the data type will be Fast)	= ; <>	Peak, Fast, Fast Inst., Fast Max, Fast Min, Impulse, Impuls Inst, Impuls Max, Impuls Min, instantaneous, Isel, Leq, Min, RC, RC Inst., RC Max, RC Min, SEL, Slow, Slow Inst, Slow Min, Slow Max, Tmax 3, Tmax 5
X axis quantity	Physical unit of the X axis	= ; <>	Bark, dB, Hz, Order, Scalar
Y1 axis quantity **Y2 axis quantity**	Physical unit of the Y-axis. For cross-spectra, Y1 corresponds to the physical unit of the first item and Y2 corresponds to the physical unit of the second item used to calculate the cross spectrum	= ; <>	Acceleration, counter, displacement, force, jerk, Noy, pressure, rate, rate (DC), second, scalar, sone (D, F, GD, GF), voltage, velocity, W/m²
ID	Identifier of the data item. A number. This number is incremented (from 0) each time a data item is added to the measurement session.	< ; <= ; <> ; = ; > ; >=	Manual input of a number
Information	Information on some calculation results (order analysis, …)	@ ; =	Manual input
Location	Location defined during acquisition (Channel 1 by default). For cross spectra, it corresponds to the location of the first measurement channel.	@ ; =	Manual input of a location

Fields column	Description (Fields column)	Op column	Value column
Name	Name of the analysis that created this data item. It is the name of the operator for an off-line analysis and the name of the acquired quantity for a real-time measurement.	@ ; =	Manual input
Average type	Type of averaging method used to compute the data item	= ; <>	Max, Min, Average, Stat
1st meas. Channel no	Number of the measurement channel used to create the item. For cross-spectra, the number of each channel used to calculate the cross spectrum is described	< ; <= ; <> ; = ; > ; >=	1, 2, 3, 4
2nd meas. Channel no			
Period	Base duration or integration time of data items that vary with time.	< ; <= ; <> ; = ; > ; >=	Manual input (0,00000 seconds) 125 ms : 0.12500
Weighting	Frequency weighting applied to the data item during acquisition or off-line analysis: A, B, C, Lin weightings, vibration weightings, etc.	= ; <>	A, B, C, D, G, Lin, PL, Pla, PN, Pink A, Pink Lin, Road A, Road Lin, TPN, Wb, WBc, Wc, Wd, We, Wf, Wh, Wj, Wk
Resolution	Unit of x axis	< ; <= ; <> ; = ; > ; >=	Manual input
Building acoustics spectrum	Spectrum for the calculation of building acoustics criteria	= ; <>	Background noise, emitted noise, received noise
Statistics	Statistical index Ln	< ; <= ; <> ; = ; > ; >=	Manual input (0,00000) L99.8 : 99,8000
X axis unit	X axis unit for a quantity acquired with other software (not 01dB)	@ ; =	Manual input
Y1 axis unit	X axis unit for a quantity acquired with other software (not 01dB). For example, the temperature For cross-spectra, Y1 corresponds to the physical unit of the first item and Y2 corresponds to the physical unit of the second item used to calculate the cross spectrum	@ ; =	Manual input
Y2 axis unit			
Version	Version of the file format	< ; <= ; <> ; = ; > ; >=	Manual input (0,00000) Version 1.01 : 1,01000

Legend:

<	Less than
<=	Less than or equal to
<>	Not equal to
=	Equal to
>	Greater than
>=	Greater than or equal to
@	Contains the character string

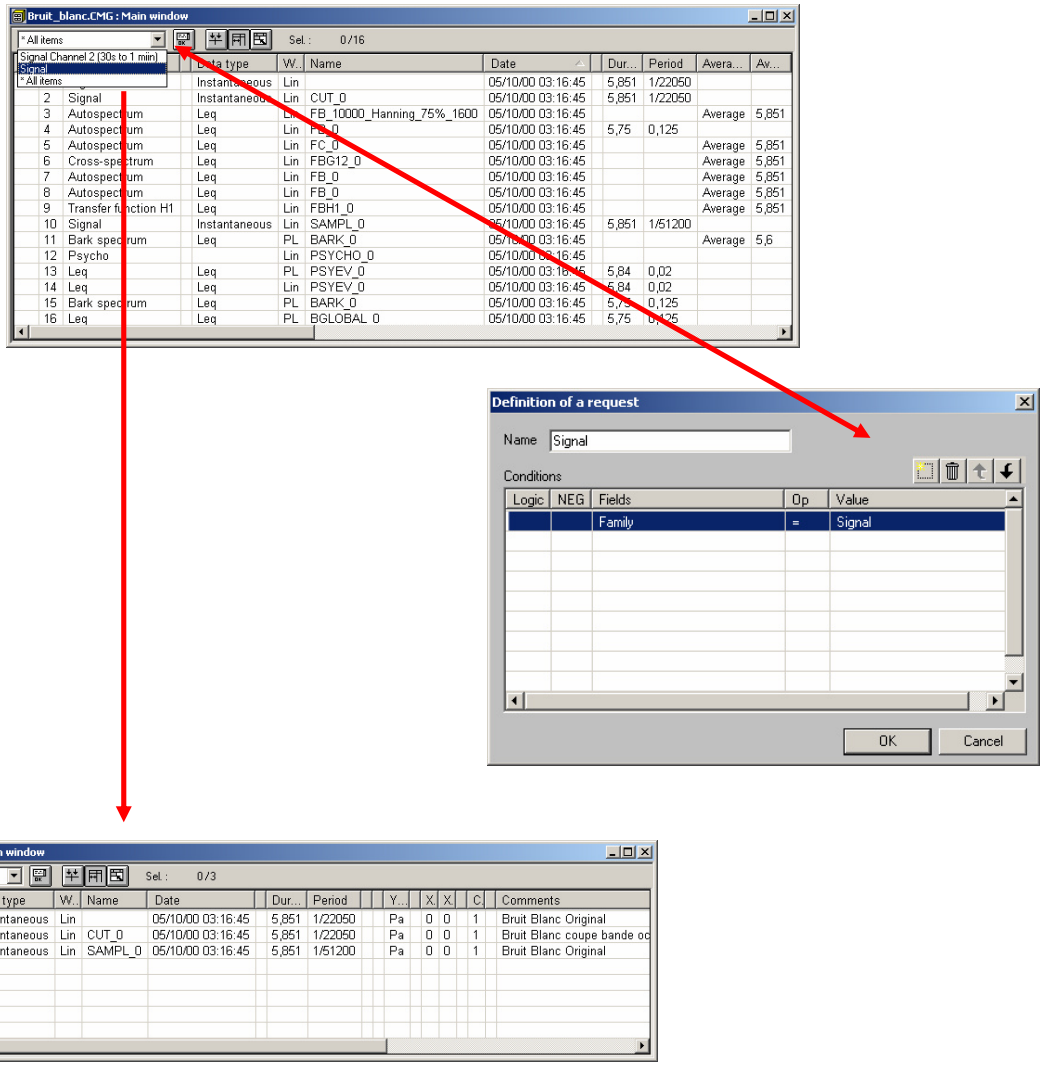
*Refer to **paragraphs 11.3** for a detailed list of the frequency weightings available in **dBFA**.*

3.6.3. Running a request

Once all the requests have been defined, use the scrolling list

of the measurement session window or the **Datafile / Current request** command.

The selected request is then executed automatically. An example of execution of a request to display only items of the Signal family is given below:

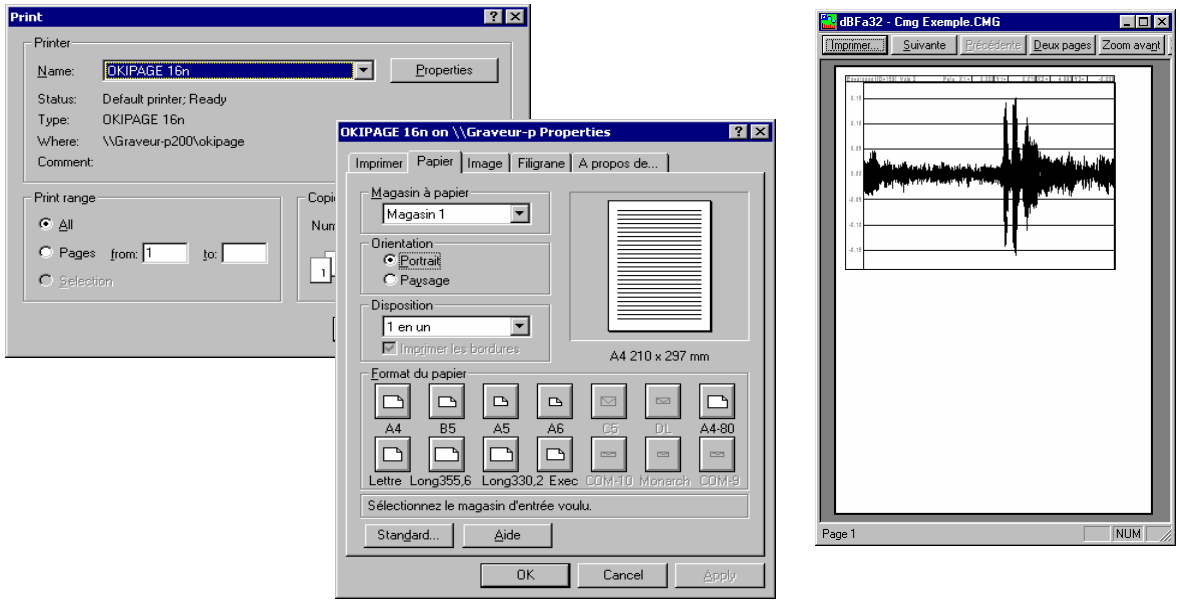


3.7. Result exploitation and customisation

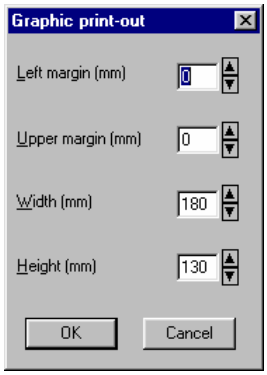
In **dBFA**, it is possible to print directly a data plot and/or a result listing and to export the results as graphics or values in standard office spreadsheet and word processor software, for further processing and result presentation. The user can also customise the way the data is displayed in the software.

3.7.1. Printing results

Using the commands of the **File** menu, results can be directly printed by **dBFA**, if a printer is connected to the computer, of course. Use the command **File / Print** (**CTRL + P**) to display the Print dialog box. Specify which pages should be printed, the number of copies, and the printer driver to use as well as other parameters (print quality, etc.).



Access directly to the printer configuration dialog box by the command **File / Print Setup** and to a preview of the document to print by the command **File / Print Preview.** The toolbar of the print preview window allows the user, for example, to zoom in the preview document.



When printing graphics, the user can set a few additional parameters by the **commands Preferences / Print options**.

The user can set the margins of the graphic printout frame.

*To print a set of graphs, select the elements to print in the measurement session and go to **File / Print selection**. Graphs will be printed using the default printing parameters.*

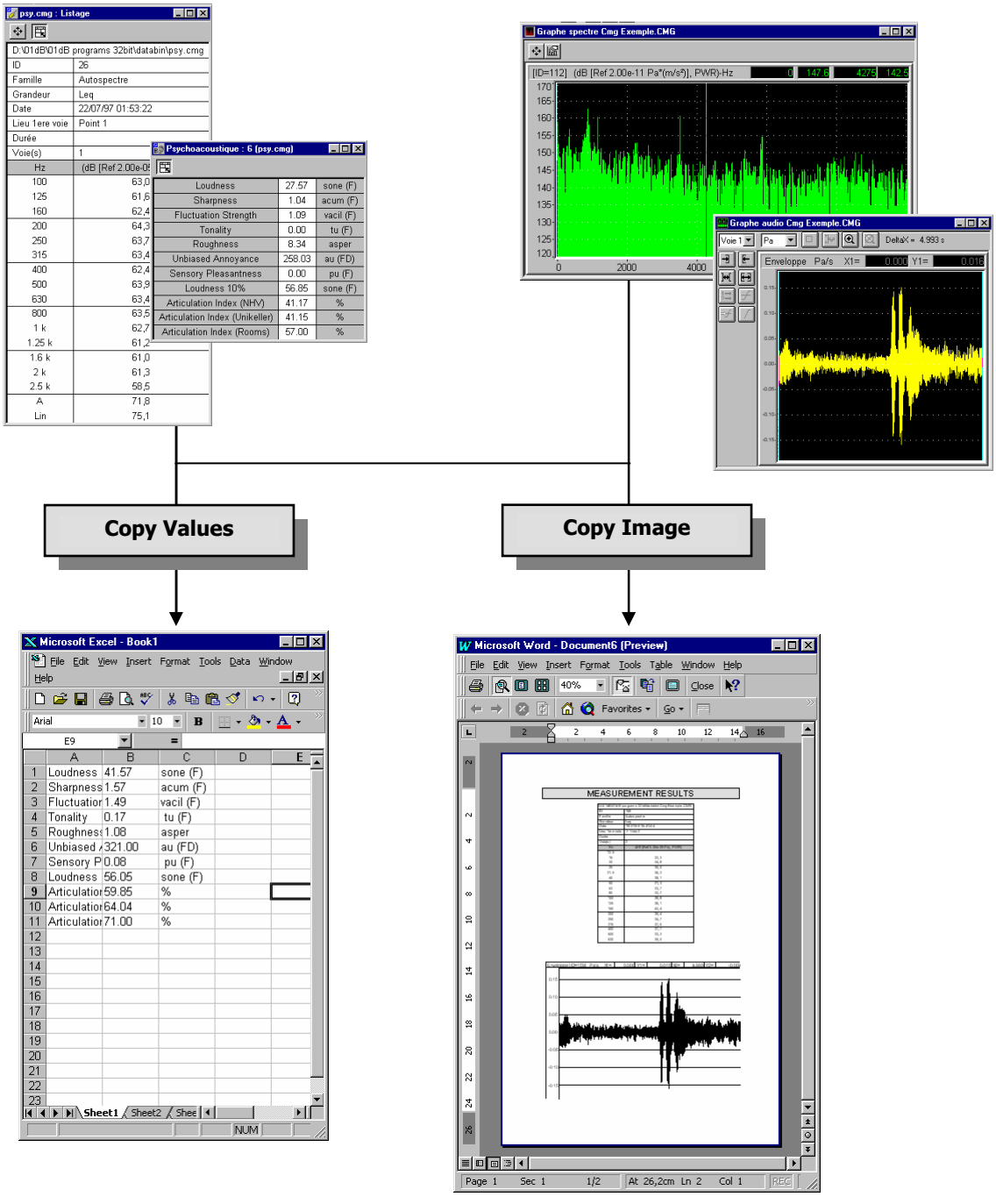
3.7.2. Exporting data to a word processing or spreadsheet software

Results can be exported either as images (graphs and data tables) or as actual values, using **Edit / Copy** (**CTRL+C**). Then paste (**Edit / Paste**) the data into a word or spreadsheet process.

To obtain frequency values in digital format after broad band spectra export, add in dBFA.ini file the following heading :

[Export]
LabelFreqNum=1

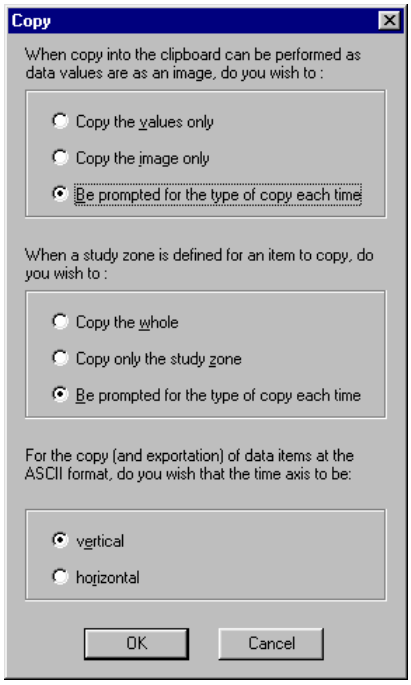
If LabelFrqNum=0, frequency values are in text format (example: "50Hz").



3.7.3. Principle and configuration of the Copy command

The copy command may be configured to work in different ways in **dBFA**. Use the command **Preferences / Copy options** to define how the copy command will work. The following dialog box appears on screen.

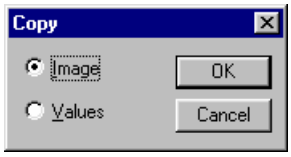
By default, for all graphical views, the command **Edit / Copy** can be used to copy the image of the graphical view. The data values cannot be copied.


Copy
When copy into the clipboard can be performed as data values are as an image, do you wish to :
Copy the values only
Copy the image only
Be prompted for the type of copy each time
When a study zone is defined for an item to copy, do you wish to :
Copy the whole
Copy only the study zone
Be prompted for the type of copy each time
For the copy (and exportation) of data items at the ASCII format, do you wish that the time axis to be:
vertical
horizontal
OK
Cancel

- **Copy of tables of results**

In some cases, for a table of results mainly, it is possible to copy either an image of the table or the data values of the table at the ASCCI format.

The default option **Be prompted for the type of copy each time** allows the user to display a dialog box for choosing to copy either the image or the values of the table of results.



The option **Copy the values only** can be used to copy directly the data values. The option **Copy the image only** can be used to directly copy the image of the table.

- **Copy of an item when a study zone has been defined**

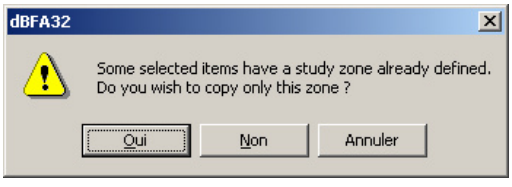
For items where a study zone can be defined (an audio signal for example), it is possible to copy the image of the view over the complete duration of the item (option **Copy the whole)** or to copy only the image of the view over the defined study zone (**Copy only the study zone**).

To obtain frequency values in digital format after broad band spectra export, add in dBFA.ini file the following heading :

[Export]
LabelFreqNum=1

If LabelFrqNum=0, frequency values are in text format (example: "50Hz").

The default option **Be prompted for the type of copy each time** allows the user to display a message to either copy the image of the view over the complete duration or the study zone. The following message appears on screen:



*See **paragraph 3.2.6** for more details on defining a study zone.*

- **Copy data items in ASCII format**

When copying directly data items from the measurement session window in ASCII format, an additional parameter is the way it will be pasted in a word or spreadsheet processor. It is also possible to export data in dB or in physical unit. Select this option using the **Preferences / Units' management** menu (see Section 19.1).

The data values can be displayed **vertically** (default value): data of X-axis and Y-axis are displayed in columns. Alternatively, they can be displayed **horizontally**: data of X-axis and Y-axis are displayed in lines.

3.7.4. Exporting data in 01dB-Metravib WAV format or in MP3 format

Select a Signal item in a measurement session and go to **File / Export** to export data in **01dB-Metravib WAV** format (Microsoft WAV format including additional information on the measurement) or in **MPEG layer III** (MP3) format.

To export a set of signal recordings, use the operators "Export in WAV format" (section 14.6.8.2) and "Export in MP3 format" (Section 14.6.8.3).

3.7.5. Exporting data in ASCII format (.TXT text file)*

The **File / Export** command is used to copy data from one or several items in a measurement session into a text file (*.txt) in ASCII format. These files can be opened with many applications: Windows NotePad, word processor, spreadsheet application, database. Any operation can then be performed to edit a measurement report or do calculations on the data. Each field in the ASCII file is separated from the other by a "tab" character, making it easier to import these files into a spreadsheet processor.

3.7.6. Exporting data in UFF format (Universal File Format)

Select one or several items in a measurement session, go to **File / Export** and select the "Universal File" (*.UFF) file type to export data in UFF format.
This file format is universal and recognised by many measurement systems.

3.7.7. Exporting data in Lexade format (Exploitation and Analysis of Test Data)

Select one or more items in a measurement session list, use the command **File/Export** and "Lexade (*.LXD)" to export data at Lexade format.

3.7.8. Exporting data in ME'scope format (Modal analysis software)

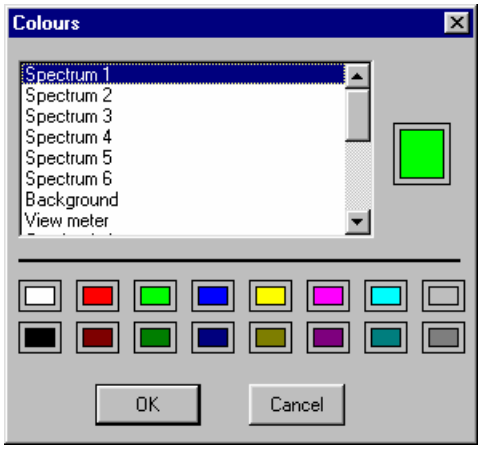
Select one item in a measurement session list, use the command **File/Export** and "ME'scope (*.BLK)" to export data at ME'scope format (modal analysis software).

3.7.9. Exporting data in MATLAB format

Select one or more items in a measurement session list, use the command **File/Export** and "MATLAB (*.MAT)" to export data at MATLAB format, directly loadable from MATLAB software by load command.

3.7.10. Customisation of dBFA

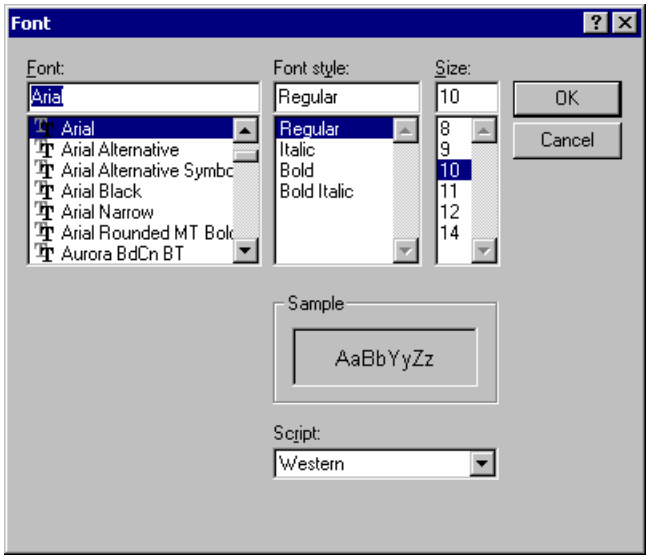
The software allows the user to customise various parameters for displaying the data.



The commands **Preferences / Colours** allows the user to respectively set the colours of the different types of data displayed on screen.

Select in this list the type of data for which you want to modify the colour. The actual colour associated to this type of data is displayed next to the list. Then, select with the mouse the new colour in the bottom part of the dialog box.

Click on **OK** when all the modifications have been carried out.

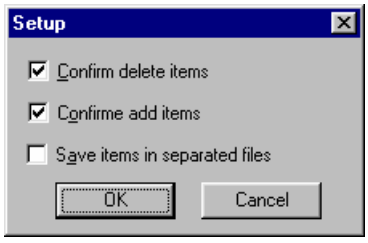


The command **Preferences / Font** allows the user to choose which computer font will be used to display text in **dBFA**.

Select the font type, style (regular, Italic, Bold, etc.) and size in this dialog box.

Click on **OK** when all the modifications have been carried out.

3.7.11. Measurement session general options



Use the **Preferences / Measurement session** command to define general parameters about the management of measurement session datafiles.

The **Confirm delete items** option allows the user to display a dialog box to confirm or not any item removal operation in the active measurement session datafile.

The **Confirm add items** option allows the user to display a dialog box to confirm or not any item addition in the active measurement session datafile.

The **save items in separated files** option allows the user to save the different items of a measurement session files into binary files. The binary data of each item are stored in a BID (Binary Item Data) file and the references of this item are saved into the measurement session itself.

The **save automatically every X minutes** option is used to regularly save measurement sessions.

Two techniques of storage are available in the software dBFA: storage in separate files or storage grouped:

- Storage in separated files, the various elements of a measurement session (items) are saved in binary files. The binary data of each item are stored in a BID file (Binary Item Data) and the references in the measurement session (CMG). The size of each item should not exceed **500Mo**. This storage is used by activating the option **Save items in separate files**.

- Storage in grouped file allows to gather the whole of the data in a single file CMG. It's a "container" structure. However the size of the CMG should not exceed 800Mo (by including all acquisitions and treatments). This storage is used by deactivating the option **Save items in separate files**.

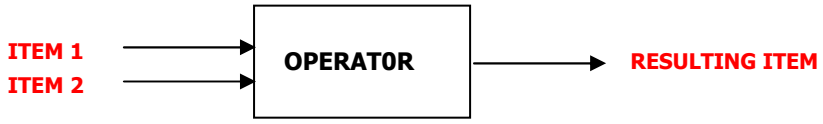
Note: The software dBRTA automatically stores its acquisitions and treatments in separated files, but it's possible to gather the files in post processing with dBFA.

4. OFF-LINE PROCESSING

4.1. Introduction

Data processing in **dBFA** can now be performed in a global manner thanks to the implementation of analysis scripts. Each processing operation is available as operators, which assembled in series or in parallel compose an analysis **script**. The scripts available in the application software are regrouped in a **calculation server**, with a user interface to configure and run an off-line analysis.

An **operator** can be represented as a black box, with a single or several inputs and an output. Each of them corresponding to data items stored in a measurement session datafile.

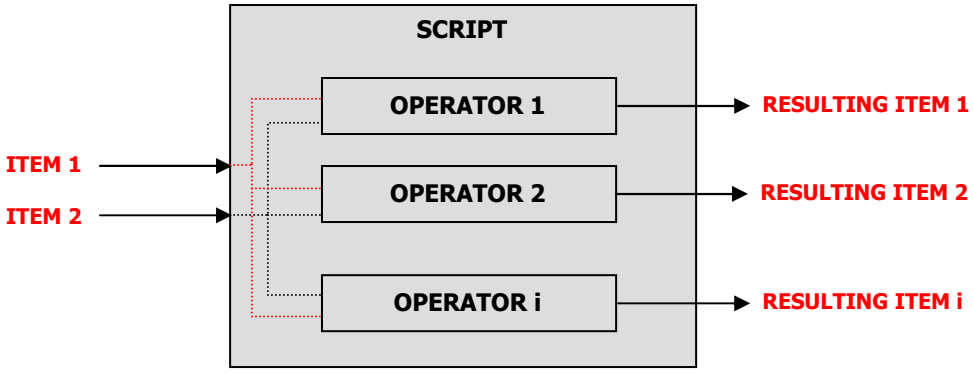


Each operator has its own configuration dialog box, allowing the user to define analysis parameters if required (e.g. Number of lines and frequency range for a narrow band FFT analysis). The name and a description of each operator, as well as notification of the computation progress, are also available.

A **script** regroups several operators, assembled in series or in parallel. One can therefore build up a complex analysis script from these simple "layers".

The script structure also help to check that the analysis is coherent (compatibility of the output items of one stage and the input items of another stage) and to activate each operator when all entities (inputs, analysis parameters) are available to run the processing function.

In the actual version, the operators cannot be assembled in series. A script therefore regroups operators in parallel, acting independently from one another, to process the same input data items.

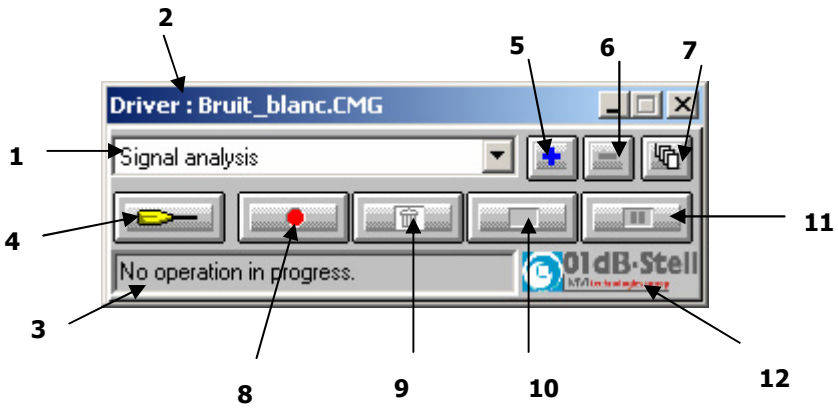


All the scripts available in 01dB-Metravib application software are themselves regrouped into a **calculation server**, with a user interface to configure and run an off-line analysis.

dBFA proposes a set of pre-defined scripts, managed by the calculation server. It allows the user to activate, configure, stop, and suspend an off-line analysis.

4.2. Calculation server overview

When a measurement session datafile is opened, use the command **General / calculation server** to launch the calculation server allowing the user to define and execute post-processing analyses. The following user-interface is displayed on-screen:



1. **List of scripts:** this list shows all analysis scripts that are compatible with the data items selected in the measurement session datafile. According to the status of the calculation server (analysis in progress, waiting, and pause) and the user actions (stop analysis, activate an analysis), these scripts are accessible for edition and configuration.

2. **Pilot measurement session:** the title of the window indicates which document (measurement session or a batch) is currently controlling the calculation. When selecting items in a measurement session (or in a batch), the calculation server gives only access to the analysis scripts that are compatible with the data items to analyse. The user may then select a script by selecting it in the list.

3. **Status bar:** this zone shows, when a script is being executed, the name of the active operator as well as the ID of the data item currently being analysed.

4. **Configuration of a script:** click on this key to display the script configuration dialog box (see **paragraph 4.3**).

5. **Duplication:** click on this key to duplicate a default script of the application software in order to rename it, to select different operators or to change analysis parameters.

   For example, the application software may offer only one script for audio data analysis. If the user wishes to keep this script with the current settings, he (or she) can duplicate the script and define different analysis types and analysis parameters. The default and user-defined scripts are automatically saved for any subsequent analysis.

6. **Cancellation:** click on this key to delete a user-defined script (obtained after duplication) from the calculation server. Default scripts cannot be deleted.

7. **Access all scripts:** click on this key to display and access all the analysis scripts contained in the calculation server, and not only the scripts compatible with the data items selected in the measurement session. In this mode, no analysis can be performed. Click again on the same key to unlock the calculation server and perform an analysis.

   This mode is also used to assign operator scripts to shortcut buttons in the session toolbar. See the section on shortcuts for operator scripts.

8. Click on this key to **launch** the analysis process according to the selected script and for the selected data items.

9. **Abort:** the script currently being executed is stopped. The analysis is thereby aborted. No result is saved in the measurement session datafile.

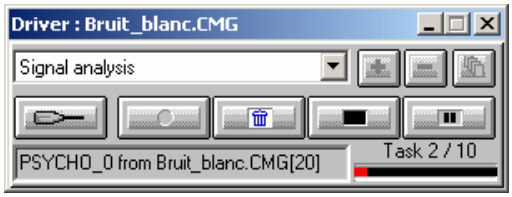
10. **Interrupt:** click on this key to interrupt the analysis process. The partial results are saved into the active measurement session datafile.

11. **Pause:** click on this key to temporarily stop the analysis process. The analysis will be carried out again when this key is pressed again.

12. **Logo /Computation progress:** this part of the dialog box shows the current progress in the computation for the operator displayed in the status bar. According to the type of operator, this zone may take different aspects:

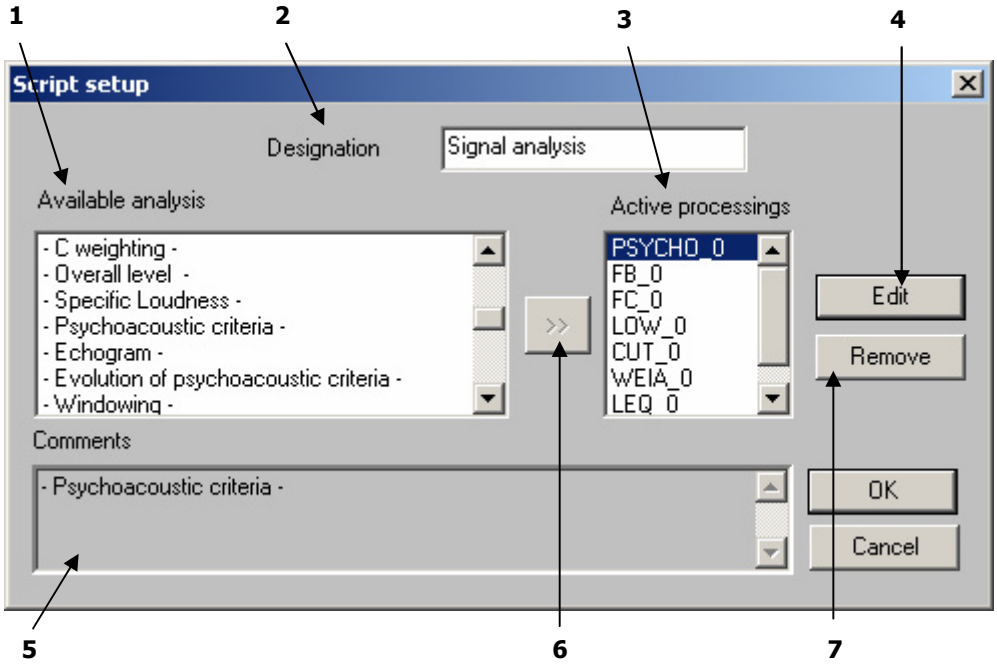
    - **Proportional bar:** it notifies the user of the computation progress with a scale ranging from 0 to 100 % (figure on the left hand side)

    - **Symbol bar:** it shows the computation progress of the current task, for operators made of several operations (figure on the right hand side). Because of the complexity of some calculations (such as computation of psychoacoustic criteria), the server cannot know in advance how much time is required to complete the calculation). The task currently being processed and an overall progress bar are therefore shown on screen.



4.3. Overview and configuration of analysis scripts

Click on the icon to access to the script configuration dialog box shown below. This dialog box is used to select and configure each single operator of the script.



1. List of **available processings**: it shows all the types of processings compatible with the active script. The same operator can be used several times with different parameters to process the same items.

2. **Designation**: give a name to the script. A user-defined name can be specified.

3. Set of **active processings** currently part of the script. These operators will be activated to analyse independently the same set of items when running the script.

4. **Edit** the parameters of the selected operator (in the list of available processings). Each operator shows its own configuration dialog box.

5. Comments describing the operator selected in the available processings' list. If an operator from the active processings' list is selected, the comment field shows the type of the operator.

6. **Key** that allows adding an operator into the active processings' list. Different operators of the same type may be added (the user may for example define a multispectrum analysis in third octave band with different time steps in the same script). A generic name for each operator is given by default.

7. The key **remove** allows the user to remove an operator from the list of the active processings.

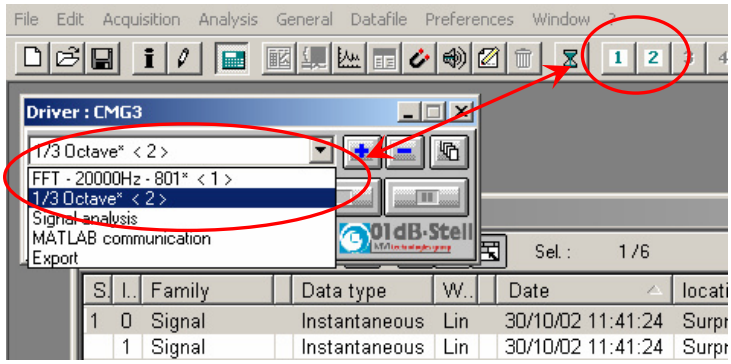
Once the list of active processings has been defined, edit each one of them to define the calculation parameters.

To do so, select the adequate operator in the list and press the **Edit** key.

4.4. Using shortcuts to run scripts

The **dBFA** interface allows to launch operator scripts directly from the shortcut buttons in the session main toolbar.

Each of the six buttons can be assigned to a predefined script in the calculation server.



The calculation server will display the shortcut number next to the script name, as shown opposite.

4.4.1. Assigning shortcuts

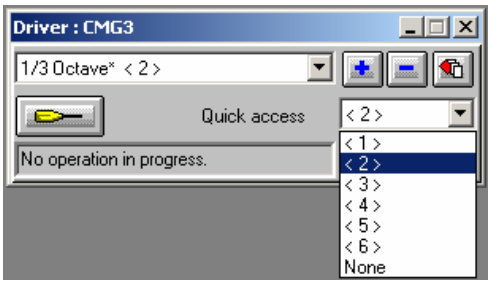
❶ Use or General / Calculation server

❷ Use to consult all scripts in the server, and not only those corresponding to the selection in the measurement session.

❸ Select a calculation script in the pop-up list

, and change the settings if need be using .

❹ Select the shortcut number on the pop-up list on the right:



The corresponding shortcut button becomes active in the toolbar:

Note: To delete an existing shortcut, select a script in the list on the left, then select "None" in the quick access list.

4.4.2. Using shortcuts

Once shortcuts have been assigned, calculation scripts can be launched by clicking on the shortcut buttons in the session toolbar.

❶ Select one or more items in the session (depending on the operations to perform).
Shortcut buttons corresponding to operations compatible with the selected items are enabled.

❷

Click on the shortcut button to launch the corresponding script.

Note: Shortcuts cannot be used in a batch analysis.

4.4.3. Quick editing of a script associated with a shortcut

A script associated with a shortcut button can be directly edited, without going into the calculation server.

To do so, click on the shortcut button for which you want to modify the script while holding down the "Shift" key.

SHIFT + **= EDITING**

4.5. List of default analysis scripts and associated operators (processing functions)

The table shown below gives a complete description of the default scripts contained in the calculation server, with associated operators and types of data items it can be used with.

Script	Operator [Default name]	Description / Result	Active for
TACHOMETRY	Order extraction [EXO_0]	From a tachometric channel and a measurement channel, this operator performs the order extraction with a selection of the method (constant resolution in order or in frequency)	**One Signal item and one Speed profile**
	Order filtering [FIO_0]	This process uses an order tracking time filter from a tachometric channel. Filter characteristics (min/max order), as well as tracking timing, are user-selected.	
	Cycle defects [ACY_0]	This process characterises cycle defects with respect to a reference tachometric channel.	
	Order / Phase extraction [OAF_0]	This operator performs an order extraction from a Signal item and a Tacho item (resulting from the recording of a tachometric transducer on a dynamic channel). This operation yields: • A multispectrum versus speed containing phase information, • An overall level per extracted order versus speed, • An item containing information on the phase per extracted or	
	Order extraction by successive levels [EOP_MULT_0]	This processing carries out, from a speed profile channel and a measurement channel, the order extraction with method choice (constant resolution in order or in frequency). The extraction is performed by successive levels, for stabilized values of the speed.	
	Calculation of order spectra by TFD [OA_DFT_0]	From a speed channel and a measurement channel, this processing calculates order spectra by discrete Fourier transform.	
SPECTRA OPERATIONS	Frequency recomposition [RECOMPF_0]	Recomposition of a broad band or narrow band multispectrum into a multispectrum of different frequency bandwidth, including Loudness/bark.	**Autospectrum, Intensity (active, reactive, free field)**
	Time recomposition [RECOMPT_0]	Recombination a broad band or narrow band multispectrum on a different time basis Calculation of minimum / maximum / averaged spectrum, Extraction of an instantaneous spectrum for which the overall level meets user-defined criteria.	
	Overall level time history [GLOBAL_0]	Time history of the overall level of a multispectrum, with frequency weighting.	
	Cepstrum [CEPS_0]	This process calculates the cepstrum from a narrow band average spectrum.	

Script	Operator [Default name]	Description / Result	Active for
TRANSFER FUNCTIONS	Cross spectrum G21 [FBG21_0]	This processing produces, from a cross-spectrum, the cross-spectrum defined as its associated complex.	**Autospectrum Channel 1 + Autospectrum Channel 2 + Cross-spectrum Ch.1 - Ch. 2**
	Transfer function [FBH1_0]	This processing produces, from the autospectrum Gxx of the input signal and the cross spectrum Gxy between the input and the output, the transfer function defined by Gxy / |Gxx|.	
	Inverse transfer function [FBIH1_0]	This processing produces, from the autospectrum Gxx of the input signal and the cross spectrum Gxy between the input and the output, the transfer function defined by |Gxx| / Gxy|.	
	Cross transfer function [FBH2_0]	This processing produces, from the autospectrum Gyy of the output signal and the cross spectrum Gxy between the input and the output, the transfer function defined by |Gyy| / Gyx.	
	Inverse cross transfer function [FBIH2_0]	This processing produces, from the autospectrum Gyy of the output signal and the cross spectrum Gxy between the input and the output, the transfer function defined by Gyx / |Gyy|.	
	Coherence [FBCOH_0]	This processing produces, from the autospectra Gxx and Gyy of the input and output signals and the cross spectrum Gxy between the input and the output, the coherence defined by $Co^2 = [\ \|Gxy\|^2\ ] / [\ \|Gxx\| . \|Gyy\|\ ]$.	
DERIVATION / INTEGRATION	Derivation / Integration [FBID_0]	Integration or derivation of an autospectrum or a cross spectrum (acceleration, velocity, displacement).	**Autospectrum or cross-spectrum (acceleration, velocity, Displacement)**

Script	Operator [Default name]	Description / Result	Active for
CONVOLUTION	Convolution [CVL_0]	This operator performs the convolution of a signal by an impulse response.	**A Signal item and an Impulse Response**
HISTOGRAM	Histogram [HISTO_0]	Histogram of a global quantity, with selection of the class bandwidth (in dB) and limits.	**Leq***
DUAL AUDIO ANALYSIS	Cross-spectrum [FBG12_0]	Narrow band cross-spectrum with time history capability (narrow band multispectrum) and frequency zoom. The user specifies the FFT window, the overlap and the number of lines.	**2 Signal items**
AUDIO ANALYSIS	Broad band spectrum [FC_0]	Broad band spectrum, ranging from octaves to 1/48th octaves, with time history capability (broad band multispectrum). The user may either use digital filtering (Class 0 IEC1260) or FFT synthesis.	**1 Signal item, or an Impulse Response**
	Narrow band spectrum [FB_0]	Narrow band spectrum, with time history capability (narrow band multispectrum) and frequency zoom. The user specifies the FFT window, the overlap and the number of lines.	
	Undersampling [DECIM_0]	Undersampled time signal, fixed by the user. A low-pass filter (Butterworth order 20) ensures anti-aliasing, the undersampling ratio varies between 2 and 50.	
	Low pass filtering [LOW_0]	Low-pass filtered time signal (Butterworth, even order from 2 to 30).	
	High pass filtering [HIGH_0]	High-pass filtered time signal (Butterworth, even order from 2 to 30).	
	Band pass filtering [PASS_0]	Band-pass filtered time signal (Butterworth, even order from 2 to 30).	
	Cut-band filtering [CUT_0]	Band-cut filtered time signal (Butterworth, even order from 2 to 30).	
	Notch filtering [NOTCH_0]	Notch filtered time signal. The user defines the filter selectivity (S factor). The frequency range at -3 dB is then of fe / (PI * S) for an order 2. By increasing the order number, Attenuation is emphasised at the expense of Selectivity.	
	A weighting [WEIA_0]	A-weighted time signal. The filter used fulfils Type 0 requirements of standard IEC651 and equivalent.	
	B weighting [WEIB_0]	B-weighted time signal. The filter used fulfils Type 0 requirements of standard IEC651 and equivalent.	
	C weighting [WEIC_0]	C-weighted time signal. The filter used fulfils Type 0 requirements of standard IEC651 and equivalent	
	Overall level [LEQ_0]	Short Leqs time history of the time signal. Frequency (Lin, A, B, C) and time (Leq, Peak, Fast, etc.) weightings can be applied.	
	Specific Loudness [BARK_0]	Bark band specific Loudness, with time history capability (specific Loudness multispectrum), a time step <= 50 ms is required for later psychoacoustic criteria computation. The result is expressed in sones, according to Zwicker B.	

* Leq family: Overall noise quantity integrated over time (Short Leq, Fast, Slow, Impulse, etc.)

Script	Operator [Default name]	Description / Result	Active for
AUDIO ANALYSIS	Psychoacoustic criteria [PSYCHO_0]	Stationary psychoacoustic criteria: Loudness, Loudness 10%, Fluctuation Strength, Sharpness, Tonality, Roughness, Unbiased Annoyance, Sensory Pleasing Sound, and Articulation Index.	**1 Signal item, or an Impulse Response**
	Echogram [ECHOG_0]	Octave or third octave echogram	
	Evolution of psychoacoustic criteria [PSYEV_0]	time history of a psychoacoustic quantity : Loudness (Zwicker B), Sharpness	
	Windowing [WIN_0]	User-defined time weighting window on a time signal, defined with segments of classical windows. (Hanning, Rectangular, Flat Top, etc.)	
	Gain optimisation [GAIN_0]	This processing amplifies time signal DAC data in order to optimise, for example, the replay level. The physical level remains unchanged.	
	Re-sampling [SAMPL_0]	This processing re-samples the audio signal to a frequency specified by the user.	
	Capon transform [CAPON_0]	This processing calculates the Capon time-frequency transform.	
	Denoising [DENOIS_0]	This processing performs denoising of a signal by decomposition/recomposition in wavelets.	
	Pseudo Wigner-Ville [WVI_0]	This processing performs smoothed pseudo Wigner-Ville transform of a signal	
	AR Model [AR_0]	This processing performs an autoregressive modelling on a fixed length sliding window.	
	Morlet [MOR_0]	This processing performs a Morlet wavelet decomposition.	
	Tachometric-Speed conversion [RPMTACH_0]	This processing yields the speed (in rpm) versus a tachometric signal acquired on an input channel.	
ARITHMETIC	Addition [PLUS_0]	Sums up all the selected quantities. The user may choose either to perform an arithmetic or an energetic sum. **Do not apply to complex spectra**	**From 2 signals, autospectra, Leq Cross-spectra, Transfer functions , coherence (complex spectra)**
	Subtraction [MOINS_0]	Subtracts all the selected quantities. The user may choose either to perform an arithmetic or an energetic subtraction. **Do not apply to complex spectra**	
	Averaging [MOY_0]	Average all the selected quantities. The user may choose either to perform an arithmetic or an energetic average.	
EXPORT	Export in MATLAB format [MATLAB_0]	This function exports the input quantity to the MATLAB format (.MAT file). This file can be directly processed into MATLAB with the "load" function.	**1 or more signal items**
	Export in 01dB-Metravib WAV format [WAV01DB_0]	This processing exports the input quantity at the WAV 01dB-Metravib format (*.WAV file, Windows compatible).	
	Export in MP3 format [MP301DB_0]	This processing exports the input data in MPEG Layer III (MP3) format. The exported signal must be sampled at 32 or 44.1 kHz	
OPERATIONS ON PARTIAL LOUDNESS	Overall Loudness level time history [BGLOBAL_0]	This analysis results in the overall Loudness level time history of a Loudness/Bark multispectrum.	**Bark spectrum**

4.6. Overview and configuration of operators (processing functions)

An operator is used to perform an analysis on a single or several data items. Each operator has its own name (that the user can modify), analysis parameters and computation progress information.

When an operator process a data item, this input quantity is locked in the active document. It cannot be deleted and the document that controls the calculation server cannot be closed. These items are unlocked when the calculation is ended or aborted.

The following paragraphs present each operator: definition, set-up parameters, compatibility, etc. The operators are presented as follows:

- **Spectral analysis**

Theory, narrow-band and broad-band spectra and multispectra, narrow-band cross-spectra, pseudo Wigner-Ville transform, decomposition in Morlet wavelets, Capon transform, autoregressive modelling on a sliding window.

- **Operations on Signal data**

Theory, low-pass, high-pass, band-cut, band-pass, notch filtering, undersampling, A, B and C frequency weightings, user-defined time windows, gain optimisation, re-sampling, denoising, tachometric conversion, convolution.

- **Operations on spectra**

Theory, frequency recomposition in broad bands and Loudness/Bark bands, time recomposition, integration/ derivation.

- **Transfer functions**

Theory, cross-spectra, transfer functions and coherence.

- **Arithmetic**

Theory, addition, subtraction and averaging.

- **Time history of an overall quantity**

Theory, Short Leq time history, Extraction of Leq level from a multispectrum, Extraction of a Loudness level from a multispectrum in bark bands.

- **Psychoacoustics**

Theory, stationary psychoacoustic criteria, spectra in bark bands, specific Loudness, time history of psychoacoustic criteria.

- **Audio data export**

Theory, export to MATLAB format, to WAV (01dB-Metravib) format, and to MP3 format.

- **Operations on overall levels**

Theory, histograms.

- **Room acoustics**

Theory, echogram.

- **Tachometry**

Theory, order extraction, order filtering, cycle defects.

4.6.1. Spectral analysis

4.6.1.1. Theory

Three types of analysis allow the user to estimate the averaged or "instantaneous" frequency contents of a signal: **narrow-band analysis, broad-band analysis and Time-frequency Analysis.**

- **Narrow-band analysis,** based on a classical periodogram (Welch-Wosa) or Gabor analysis, with selection of an overlap, a weighting window and a zoom factor. A time integration can be selected to generate a multispectrum. This analysis can be applied to a couple of input quantities, in order to calculate a cross-spectrum.

The Fourier transform of a signal called x(t) (respectively y(t)) results in a complex autospectrum Gxx (respectively Gyy) given by:

$$Gxx(f) = \int_{-\infty}^{+\infty} x(t).e^{-j2\pi ft}dt$$

We often represent autospectra as a modulus only. We therefore call "autospectrum" the modulus of an autospectrum (complex quantity with a modulus and a phase).

Let us designate the real and imaginary parts of Gxx by Gxxr and Gxxi respectively. Then:

|Gxx|² = Gxxr.Gxxr + Gxxi.Gxxi

The result, expressed in dB, is equal to:

20.log10(|Gxx|/REF)

With REFX=$2e^{-5}$ for sound pressure levels.

If the selected physical unit is not the IS unit, and if a conversion factor Cx is calculated (e.g.: Cx=9.81 for an acceleration level expressed in g), then the above expression becomes:

20.log10([|Gxx|.Cx]/REF)

The cross-spectrum between channel x and channel y can be computed from the autospectra Gxx and Gyy using the formula:

Gxy = Gxx.Gyy*

Where Gyy* is the conjugated complex of Gyy (same real parts, opposed imaginary parts).
The modulus of the result, expressed in dB is given by:

20.log10(|Gxy| / [REFX. REFY])

It the selected physical unit is not the IS unit, and if a conversion factor Cx is calculated (e.g.: Cx=9.81 for an acceleration level expressed in g), then the expression above becomes:

20.log10([|Gxy| . Cx . Cy]/ [REFX. REFY])

The phase of the result, expressed in radian, is equal to:

atan(Gxyi/Gxyr),

Where Gxyr et Gxyi respectively designate the real and imaginary part of Gxy.

By convention, the cross-spectrum between a 50 dB sinusoid and a 60 dB sinusoid of the same frequency gives a level of 55 dB.

- **Broad-band analysis**, from octave bands to 1/48th octave bands, with selection of the method (FFT narrow-band recombination for 5 lines minimum or Class 0 standardised digital filtering). A time integration can be selected to generate a multispectrum.

In both cases, the algorithm uses undersampling in order to optimise the ratio between the sampling frequency and the maximum frequency of analysis. Then, for each octave band below the highest one, the signal is undersampled by a factor 2 in order to keep this optimal ratio for each computation pass. We therefore obtain a fast, simple and reliable algorithm, allowing the analysis to reach low frequencies.

FFT synthesis:

This method is based on the computation of an autospectrum in narrow bands, in accordance to the previous definition. The narrow bands are then recombined (sum) as a function of the broad band limits (octaves and sub-division of octave bands) and the frequency band calculated.
However, FFT synthesis of a broad frequency band is allowed only if 5 narrow band lines are included in this range.

Advantages of the method

- Fast, Reliability of the FFT algorithm

Drawbacks of the method

- **Low frequency limit**: During an FFT analysis, we obtain a spectrum with lines uniformly spread over the frequency axis, with a resolution of **fs/N**, where fs is the sampling frequency and N the size of the FFT used (number of samples). However, the lower the centre frequency of an octave band (or $1/n^{th}$ octave band), the smaller the bandwidth. We therefore have only a few narrow bands to recombine a broad band at low frequencies and we often go under the limit of 5 lines for a statistically correct synthesis. Another drawback of the method can thereby be identified: high frequency broad bands are the synthesis of a large number of narrow bands while it is not the case at lower frequencies.

- **Time resolution compromise**: One can obtain a result for a given band only if the number of available points for computation (depending on the undersampling stage and the original time duration of the signal) is greater or equal to the FFT size required to synthesise this band. The number of points can be greater than the number of points required to obtain the time resolution required. The result cannot therefore be obtained for the time step, but for a greater one.

Digital filtering:

This method is based on a bench of digital filters (as many filters per octave band as there are octave sub-divisions) of the Butterworth family, of order 8. These filters consist of a chain of 4 elementary Butterworth cells of order 2.

Advantages of the method

- Accurate estimation of the result

- Time resolution very small. No limitation or time/frequency compromise.

Drawbacks of the method

- Digital filtering requires a delay to be performed, because of the delay of energy propagation induced by the physical characteristics of the filter (depending on its complexity and type). A delay therefore appears at low frequencies, because of the large number of filters used.

Time-Frequency analysis

Spectral analysis based on Fourier transform (FFT) and digital filtering (1/n octave) provides a good description of stationary and pseudo-stationary signals.
Unfortunately, there are limits to these techniques when signals to analyse are not stationary.

In this case, the solution is to calculate instantaneous spectra for each time step of the signal. Tools to do so are called time-frequency analysis techniques. There are several methods, none of which is predominant. Their use depends on the target application and on the pros and cons of each one to display requested information.

Several methods can be used by **dBFA**:

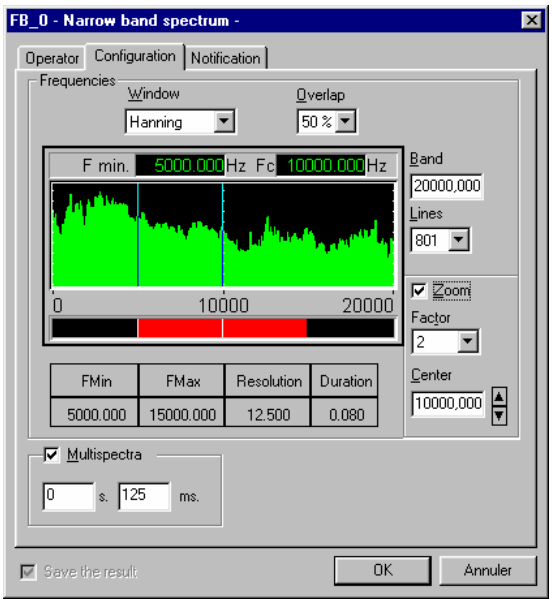
- Wigner-Ville transform (WVT)
- Wavelets transform (WT)
- Autoregressive modelling
- Capon transform

The increase in computer resources has allowed for the application of digital models of these transforms and thus obtain the time-frequency descriptions of these non stationary signals. However, even before the computer era, man, and especially the musician, has used time-frequency analysis techniques when writing music scores.

4.6.1.2. Narrow-band spectrum Operator [FB]

This analysis results in a narrow-band spectrum, with time history capability (narrow-band multispectrum) and frequency zoom. The following dialog box appears on-screen.

In the **Configuration** tab, the following analysis parameters may be defined:



- **FFT Window:** Choose the FFT window for the analysis. The following windows are available: Rectangular, Hanning, Hamming, Kaiser-Bessel, and Flat Top.

- **Overlap:** Choose the overlap factor for the analysis amongst the following quantities: 0, 25%, 50% and 75%.

During a FFT analysis, the overlap factor represents the percentage of samples that are used simultaneously in two adjacent data blocks.

- **Max. frequency:** Select the maximum frequency of the analysis.

The pass band defines the maximum frequency of the analysis. A scrolling list indicates the available maximum frequencies.

- **Lines :** Select the number of lines for the FFT analysis amongst the values displayed in the list: 101, 201, 401, 801, 1601 or 3201. The higher the number of lines the higher the frequency resolution.

- **FFT zoom**

This group allows the user to define the parameters of a FFT zoom. The zoom allows the user to reduce the frequency range of analysis around a centre frequency and thereby increase the frequency resolution. Select **Zoom,** in order to activate the FFT zoom option. Then choose the **centre frequency** and the **zoom factor**.

The curve on the left-hand side informs the user about the chosen parameters. The red information bar (lower part) indicates the analysis frequency range while the spectrum indicates the chosen frequency resolution.

To modify the centre frequency or the minimum frequency (when the Zoom option is activated) of analysis, move the cursors respectively to the right and to the left. The user can also modify the zoom parameters by setting the zoom factor and the centre frequency in the right part of the dialogue box.

- **Multispectra**: if this option is activated, the user obtains the time history of the spectrum over the item duration. The time step may vary from 1 ms to 999 ms.

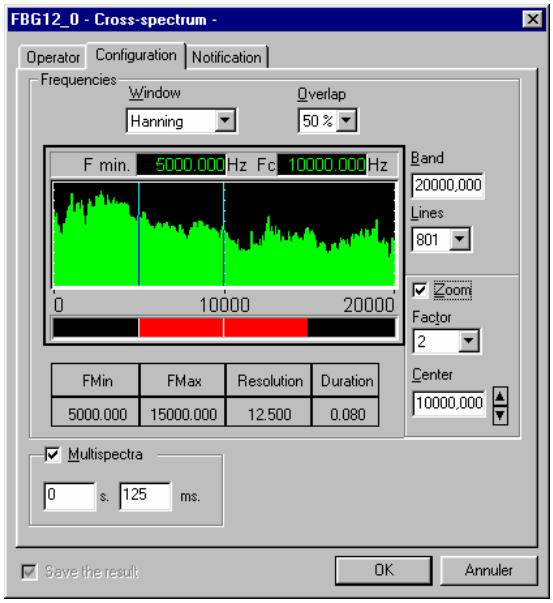
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**FB_0**
Active for	**Signal, Impulse Response families**
Restrictions	**Only apply for one item** **The length of a time block must smaller than that of the signal**
Family of the result	**Autospectrum**

4.6.1.3. Narrow-band Cross spectrum Operator [FBG12]

This analysis results in a narrow-band cross-spectrum with time history capability (narrow-band multispectrum) and frequency zoom. The following dialog box appears on-screen.

In the **Configuration** tab, the following analysis parameters may be defined:



- **FFT Window:** Choose the FFT window for the analysis. The following windows are available: Rectangular, Hanning, Hamming, Kaiser-Bessel, and Flat Top.

- **Overlap:** Choose the overlap factor for the analysis amongst the following quantities: 0, 25%, 50% and 75%.

During a FFT analysis, the overlap factor represents the percentage of samples that are used simultaneously in two adjacent data blocks.

- **Max. frequency:** Select the maximum frequency of the analysis.

The pass band defines the maximum frequency of the analysis. A scrolling list indicates the available maximum frequencies.

- **Lines :** Select the number of lines for the FFT analysis amongst the values displayed in the list: 101, 201, 401, 801, 1601 or 3201. The higher the number of lines the higher the frequency resolution.

- **FFT zoom**

This group allows the user to define the parameters of a FFT zoom. The zoom allows the user to reduce the frequency range of analysis around a centre frequency and thereby increase the frequency resolution. Select **Zoom,** in order to activate the FFT zoom option. Then choose the **centre frequency** and the **zoom factor**.

The curve on the left-hand side informs the user about the chosen parameters. The red information bar (lower part) indicates the analysis frequency range while the spectrum the chosen frequency resolution.

To modify the centre frequency or the minimum frequency (when the Zoom option is activated) of analysis, move the cursors respectively to the right and to the left. The user can also modify the zoom parameters by setting the zoom factor and the centre frequency in the right part of the dialogue box.

- **Multispectra**: if this option is activated, the user obtains the time history of the spectrum over the item duration. The time step may vary from 1 ms to 999 ms.

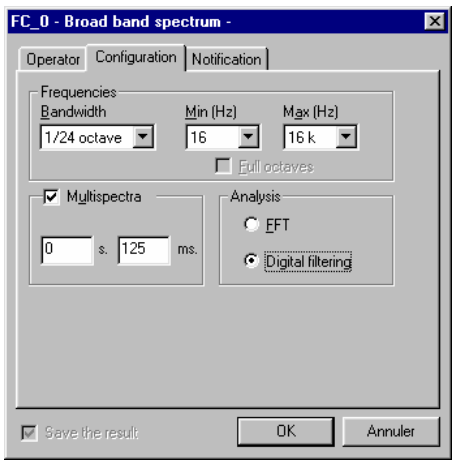
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Dual signal analysis**
Default name	**FBG12_0**
Active for	**2 items of the Signal family**
Restrictions	**Apply for 2 audio events with same sampling frequency** **The length of a time block must smaller than that of the signal**
Family of the result	**Cross-spectrum**

4.6.1.4. Broad-band spectrum Operator [FC]

This analysis results in a broad-band spectrum, ranging from octaves to 1/48th octaves, with time history capability (broad-band multispectrum). The following dialog box appears on-screen.

In the **Configuration** tab, the following analysis parameters may be defined:



- **Bandwidth** to define the spectrum bandwidth for the analysis: 1/1, 1/3, 1/6, 1/12, 1/24 and 1/48th octave bands.
- **Min:** Minimum centre frequency of analysis in Hz
- **Max:** Maximum centre frequency of analysis in Hz
- **Full octaves:** If this option is activated, the software will set the minimum and maximum frequency limits so that only full octaves are calculated.
- **Analysis:** Select the method used to perform frequency analysis: FFT or digital filtering.

- **Multispectra:** if this option is activated, the user obtains the time history of the spectrum over the item duration. The time step may vary from 1 ms to 999 ms.

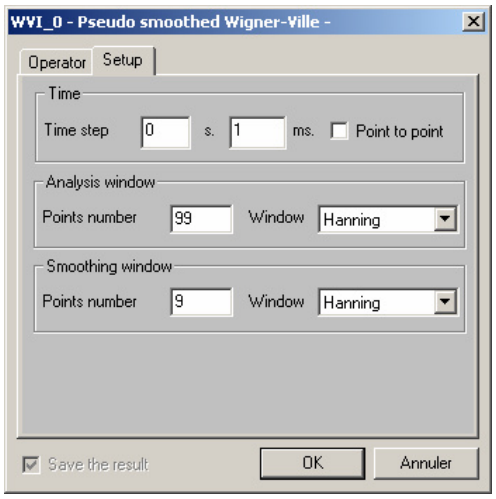
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**FC_0**
Active for	**Signal, Impulse Response families**
Restrictions	**Only apply for one item** **The time resolution required for multispectrum must be less than the item duration** **FFT synthesis: the item must be long enough to obtain at least 5 lines per broad band**
Family of the result	**Autospectrum**

4.6.1.5. Pseudo Wigner-Ville transform operator

Use this operator to obtain a multispectrum with a timing ranging up to the sample, and a good frequency resolution. The Time-Frequency ratio can reach 1/4π.
The dialog box below is displayed on screen:

In the **Configuration** tab, the following analysis parameters may be defined:



- **Time step**: Define the timing for multispectra, in milliseconds or sample by sample by checking the **Point by point** option (depends on the sampling frequency).
- **Analysis window**: Define the number of points in the time window under analysis (which corresponds to 2N-1, an odd number) and then select the weighting window to apply to the calculation. The sample "seeing back" the spectrum instant is the centre sample.
- **Smoothing window**: Define the number of points in the time smoothing window (corresponds to 2M-1, an odd number) then select the weighting window to apply to the smoothing.

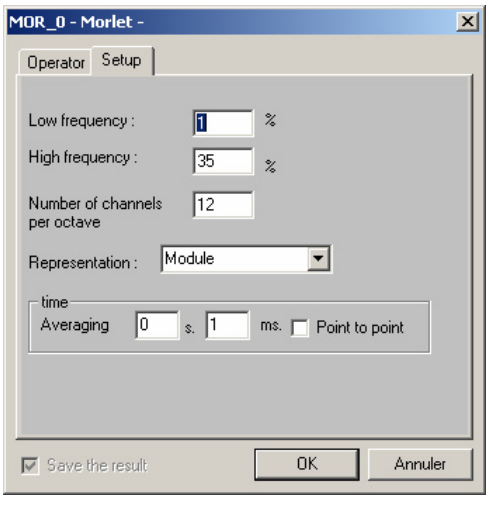
The **Operator** tab provides a detailed description of this type of processing and offers the possibility to change its name.

Default script	**Signal analysis**
Default name	**WVI_0**
Active for	**Signal family**
Restrictions	**Applies for one item only**
Result family	**Autospectrum**

4.6.1.6. Morlet wavelet transform operator

Use this operator to obtain a multispectrum with a timing down to the sample and a good frequency resolution. The Time-Frequency ratio can reach 1/4π.
The dialog box below is displayed on screen.

In the **Configuration** tab, the following analysis parameters may be defined:



- **Upper / Lower frequency:** Define maximum and minimum frequencies to study, as a percentage of the sampling frequency. The upper frequency cannot exceed 35% to avoid aliasing effect.
- **Number of channels per octave:** Define the number of channels per octave, i.e., the bandwidth (in nth octave).
- **Representation:** Select the representation: Modulus, phase, real part or imaginary part.
- **Time:** Define the timing of multispectra, in milliseconds or sample by sample by checking the Point by point (depends on the sampling frequency).

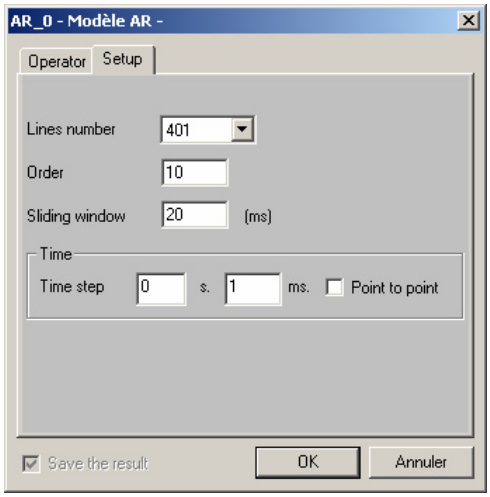
The **Operator** tab provides a detailed description of this type of processing and offers the possibility to modify its name.

Default script	**Signal analysis**
Default name	**MOR_0**
Active for	**Signal family**
Restrictions	**Applies for one item only**
Result family	**Autospectrum**

4.6.1.7. Autoregressive modelling operator

Use this operator to obtain a multispectrum with a timing down to the sample and a good frequency resolution. The Time-Frequency ratio can reach 1/4π.
The dialog box below is displayed on screen.

In the **Configuration** tab, the following analysis parameters may be defined:



- **Number of lines**: Enter the number of lines that will define the frequency resolution.
- **Order**: Define the filtering order (a high order can yield better results).
- **Sliding window**: Define the length of the time block to analyse.
- **Time**: Define the timing for the multispectra, in milliseconds or sample by sample by checking the **Point by point** option (depends on the sampling frequency).

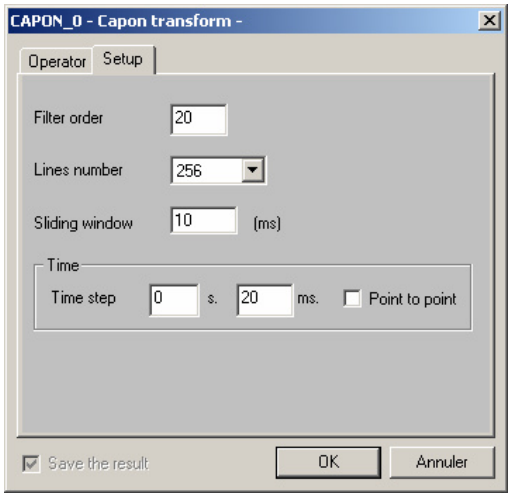
The **Operator** tab provides a detailed description of this type of processing and offers the possibility to modify its name.

Default script	**Signal analysis**
Default name	**AR_0**
Active for	**Signal family**
Restrictions	**Applies for one item only**
Result family	**Autospectrum**

4.6.1.8. Capon transform operator

Use this operator to obtain a multispectrum with a timing going down to the sample and a good frequency resolution. The Time-Frequency ratio can reach 1/4π.
The dialog box below is displayed on screen.

In the **Configuration** tab, the following analysis parameters may be defined:



- **Filter order**: Define the filtering order (a high order can yield better results).
- **Number of lines**: : Enter the number of lines that will define the frequency resolution.
- **Sliding window**: Define the length of the time block to analyse.
- **Time**: Define the timing for the multispectra, in milliseconds or sample by sample by checking the **Point by point** option (depends on the sampling frequency).

The **Operator** tab provides a detailed description of this type of processing and offers the possibility to modify its name.

Default script	**Signal analysis**
Default name	**CAPON_0**
Active for	**Signal family**
Restrictions	**Applies for one item only**
Result family	**Autospectrum**

4.6.2. Operations on Signal data

There are several types of operations that can be performed:

- **Selective digital filtering or frequency weightings**

  The digital filters used by 01dB-Metravib are recursive filters based on elementary Butterworth cells of order 2, ensuring a great stability over the frequency range.

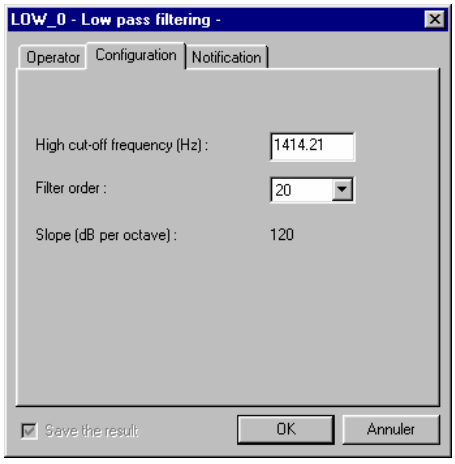
- **Time windowing by a pre-defined window**

- **Signal processing**: Resampling, undersampling, gain, denoising, convolution, envelope

- **Integration and derivation**

4.6.2.1. Low-pass filtering Operator [LOW]

This analysis results in a low-pass filtered time signal (Butterworth, even order from 2 to 30). The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **High cut-off frequency:** define the cut-off frequency in Hz.

- **Filter order.** Select the Butterworth filter order between the following values: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, and 30.

The filter order defines the octave fall-off rate (dB / octave) and therefore the effectiveness of the filter. The greater the filter order, the greater the attenuation of high-frequency bands.

Low-pass filters remove components with a frequency higher than the specified cut-off frequency with an octave fall-off rate (dB / octave) depending on the filter order.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**LOW_0**
Active for	**Signal, Impulse Response families**
Restrictions	**Only applies for one item**
Family of the result	**Signal, Impulse Response families**

4.6.2.2. High-pass filtering Operator [HIGH]

This analysis results in a high-pass filtered time signal (Butterworth, even order from 2 to 30). The following dialog box appears on-screen.

In the **Configuration** tab, the following analysis parameters may be defined:

- **Low cut-off frequency:** define the cut-off frequency in Hz.
- **Filter order:** select the Butterworth filter order between the following values: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, and 30.

The filter order defines the octave fall-off rate (dB / octave) and therefore the effectiveness of the filter. The greater the filter order, the greater the attenuation of low-frequency bands.

Low-pass filters remove components with a frequency lower than the specified cut-off frequency with an octave fall off rate (dB / octave) that depends on the filter order.

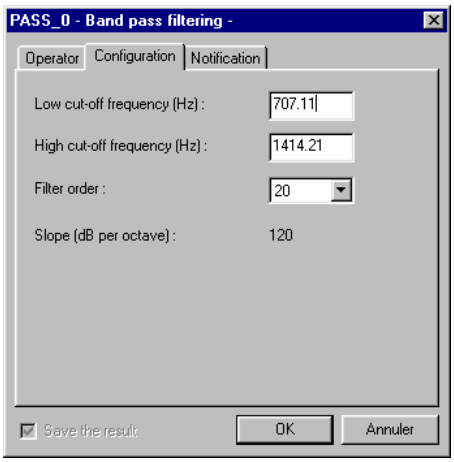
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**HIGH_0**
Active for	**Signal, Impulse Response families**
Restrictions	**Only applies for one item**
Family of the result	**Signal, Impulse Response families**

4.6.2.3. Band-pass Operator [PASS]

This analysis results in a band-pass-filtered time signal (Butterworth, even order from 2 to 30). The following dialog box appears on-screen.

In the **Configuration** tab, the following analysis parameters may be defined:



- **Low cut-off frequency:** define the low cut-off frequency in Hz.
- **High cut-off frequency:** define the high cut-off frequency in Hz.
- **Filter order.** Select the Butterworth filter order between the following values: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, and 30.

The filter order defines the octave fall-off rate (dB / octave) and therefore the effectiveness of the filter. The greater the filter order, the greater the attenuation of low and high-frequency bands.

Band-pass filters remove components whose frequency is lower than the specified low cut-off frequency and greater than the high cut-off frequency with an octave fall off rate (dB / octave) depending on the filter order. It corresponds to a low-pass filter and a high-pass filter simultaneously.

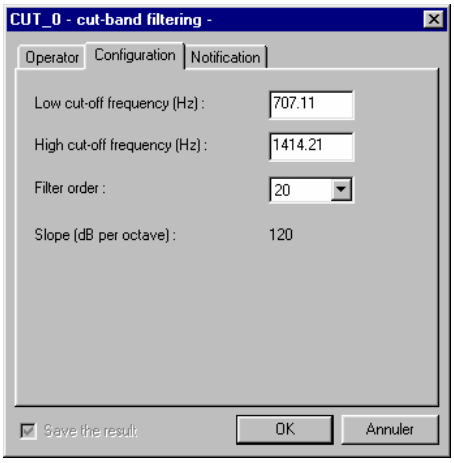
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**PASS_0**
Active for	**Signal, Impulse Response families**
Restrictions	**Only applies for one item**
Family of the result	**Signal, Impulse Response families**

4.6.2.4. Cut-band filtering Operator [CUT]

This analysis results in a band-stop filtered time signal (Butterworth, even order from 2 to 30). The following dialog box appears on-screen.

In the **Configuration** tab, the following analysis parameters may be defined:



- **Low cut-off frequency:** define the low cut-off frequency in Hz.
- **High cut-off frequency:** define the high cut-off frequency in Hz.
- **Filter order.** Select the Butterworth filter order between the following values: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, and 30.

The filter order define the octave fall-off rate (dB / octave) and therefore the effectiveness of the filter. The greater the filter order, the greater the attenuation of low and high frequency bands.

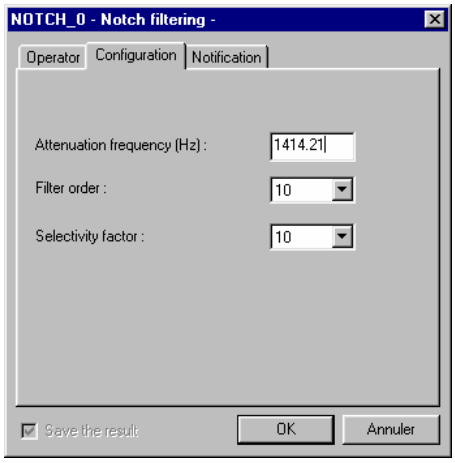
Cut-band filters remove components whose frequency lies in the range between the low cut-off frequency and the high cut-off frequency with an octave fall-off rate (dB / octave) depending on the filter order.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**CUT_0**
Active for	**Signal, Impulse Response families**
Restrictions	**Only applies for one item**
Family of the result	**Signal, Impulse Response families**

4.6.2.5. Notch filtering Operator [NOTCH]

This analysis results in a notch-filtered time signal. The following dialog box appears on-screen. In the **Configuration** tab, the following analysis parameters may be defined:



- **Attenuation frequency Fa:** define the rejection frequency in Hz.
- **Filter order.** Select the Butterworth filter order between the following values: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, and 30.
- **Selectivity factor S.** Define the selectivity parameter: 10, 20, 40 or 80.

The user defines the filter selectivity (S factor). The frequency range at -3 dB is then of fs / (PI * S) for an order 2. By increasing the order number, attenuation is emphasised at the expense of aelectivity.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**NOTCH_0**
Active for	**Signal, Impulse Response families**
Restrictions	**Only applies for one item**
Family of the result	**Signal, Impulse Response families**

4.6.2.6. Frequency A-weighting Operator [WEIA]

This analysis results in an A-weighted time signal. The filter used fulfils Type 0 requirements of IEC651 and equivalent standards.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**WEIA_0**
Active for	**Signal, Impulse Response families**
Restrictions	**Only applies for one item**
Family of the result	**Signal, Impulse Response families**

4.6.2.7. Frequency B-weighting Operator [WEIB]

This analysis results in an B-weighted time signal. The filter used fulfils Type 0 requirements of IEC651 and equivalent standards.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**WEIB_0**
Active for	**Signal, Impulse Response families**
Restrictions	**Only applies for one item**
Family of the result	**Signal, Impulse Response families**

4.6.2.8. Frequency C-weighting Operator [WEIC]

This analysis results in a C-weighted time signal. The filter used fulfils Type 0 requirements of IEC651 and equivalent standards.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**WEIC_0**
Active for	**Signal, Impulse Response families**
Restrictions	**Only applies for one item**
Family of the result	**Signal, Impulse Response families**

4.6.2.9. Vibratory weighting Operator [WEIWB], [WEIWC], [WEIWD], [WEIWE], [WEIWF], [WEIWG], [WEIWJ], [WEIWK], [WEIWBC]

This analysis results in a vibratory weighted time signal. The filter used requirements of standard ISO 8041.
Available weighting are:
Wb, Wc, Wd, We, Wf, Wg, Wh, Wj, Wk and Wbc.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**WEIWB_0, WEIWC_0, WEIWD_0, WEIWE_0, WEIWF_0, WEIWG_0, WEIWJ_0, WEIWK_0, WEIWBC_0**
Active for	**Signal, Impulse Response families**
Restrictions	**Only applies for one item**
Family of the result	**Signal, Impulse Response families**

4.6.2.10. KB-weighting [WEIWKB]

This analysis results in an KB-weighted time signal. The filter used requirements of standard DIN 45669-1 (1995-06) and equivalent.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**WEIWKB_0**
Active for	**Signal, Impulse Response families**
Restrictions	**Only applies for one item**
Family of the result	**Signal, Impulse Response families**

4.6.2.11. Windowing Operator [WIN]

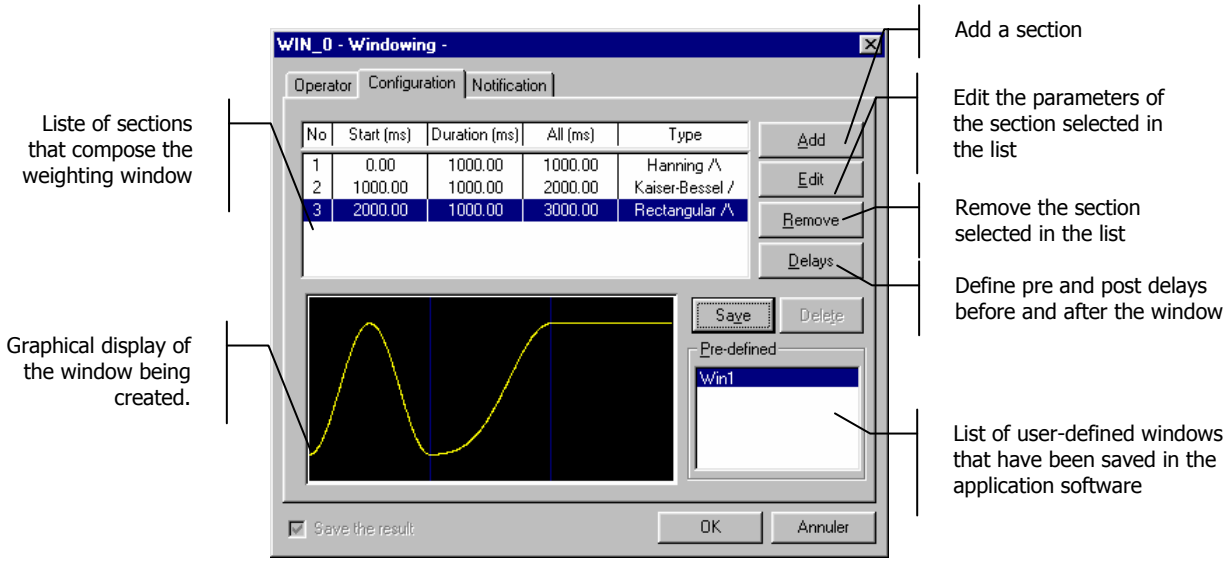
This processing allows the user to apply a user-defined time weighting window on a time signal, using segments of classical windows (Rectangular, Kaiser Bessel, Flat Top, etc.), zeros (signal set to 0) and holes.

The beginning of the window may be applied to the starting date and time of the signal study zone. Zeros, before and after the signal, of user-defined duration, may also be added in order to extract or select a portion of the signal.

Once the time window has been defined, the user may save it into a catalogue of pre-defined window (in the *.INI of the application software). This is an important feature when performing the same data processing operations.

📖 *See **paragraph 3.3.1** for more information on how to define a study zone for a time signal.*

The following dialog box appears on screen. In the **Configuration** tab, define the specific weighting window:



The operating process to configure the operator is given below:

1. Define a study zone for the signal under investigation and write down the duration of each section for which specific weighting will be applied. **This operation is really important for later definition of the sections of the weighting window.**

2. Access the Windowing operator and define the adequate segments for the signal(s) under investigation. Click on the **Add** button to add a new section, on the **Edit** button to modify an existing section and click on the **Remove** button to delete an existing section of the window.

3. Click on the **Delays** button to define delays before and after the window, if necessary.

4. Click on the **Save** button to save the weighting window in the application software. This window can be recalled later, next time the user wishes to analyse data items with the same window.

5. Close the configuration dialog box and run the analysis script (see **paragraph 4.2**)

📖 *The beginning of the time window (excepted the pre-delay) will match the beginning of the signal study zone.*

- **Add and Edit keys**

Click on the **Add** button to add a new section or on the **Edit** button to modify an existing section of the weighting window. The following dialog box appears on screen.

Select the section **duration** (in milliseconds) as well as the **type** of classical window to use: Rectangular, Hanning, Hamming, Blackman-Harris, Kaiser-Bessel, FlatTop, Triangular, Exponential, Zeros and Holes.

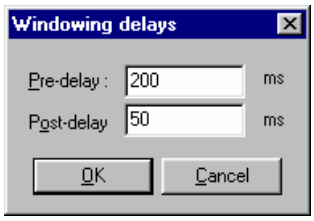
Then select if only the **rising slope (/)**, the **falling slope (\)** or the complete window **(/\)** will be part of the section.

Once the section parameters have been defined, click on **OK**. The section is then displayed in the list and the graphical display of the weighting window is updated.

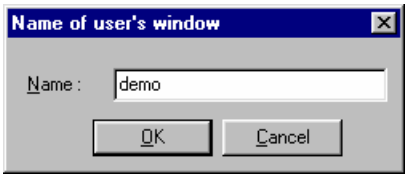
*Use the **Hole** window to cut a section of a signal. Use the **Zeros** window to remove spikes from the signal.*

- **Delay button**

Click on this key to define a delay (in milliseconds) before and after the weighting window. The following dialog box appears on screen.



Set these parameters to zero if no delay is required.



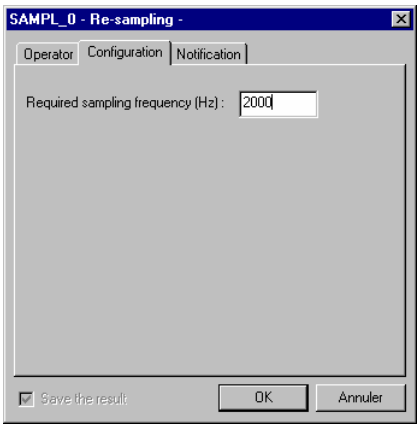
- **Save button**

Once the window has been defined, click on this key to save it for later use. A dialog box is shown on screen in order to give a specific name to that window.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**WIN_0**
Active for	**Signal, Impulse Response families**
Restrictions	**Applies for one item only**
Family of the result	**Signal, Impulse Response families**

4.6.2.12. Re-sampling operator [SAMPL]



This processing re-samples the signal to a frequency specified by the user.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**SAMPL_0**
Active for	**Signal, Impulse Response families**
Restrictions	**Applies for one item only**
Family of the result	**Signal, Impulse Response families**

4.6.2.13. Gain optimisation [GAIN]

This processing amplifies time signal DAC data in order to optimise, for example, the replay level. The physical level remains unchanged.
This optimisation can be **automatic** or **manual** according to a level defined by the user. *The manual optimisation is useful to compare signals.*

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**GAIN_0**
Active for	**Signal, Impulse Response families**
Restrictions	**Applies for one item only**
Family of the result	**Signal, Impulse Response families**

4.6.2.14. Undersampling Operator [DECIM]

This analysis results in an undersampled time signal, fixed by the user. A low-pass filter (Butterworth order 20) ensures anti-aliasing, the undersampling ratio varies between 2 and 50. The following dialog box appears on-screen.

In the **Configuration** tab, the following analysis parameters may be defined:

- **Required frequency range**: define the maximum frequency of the audio event after undersampling.

It is recommended not to undersample audio files below 2000 Hz unless source recognition, by playing back the file, is unimportant.

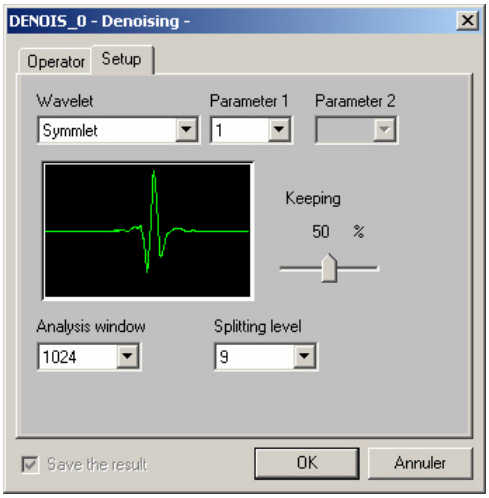
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**DECIM_0**
Active for	**Signal, Impulse Response families**
Restrictions	**Applies for one item only**
Family of the result	**Signal, Impulse Response families**

4.6.2.15. Denoising operator [DENOIS]

This processing is used to clean the signal and improve the signal-to-noise ratio. The dialog box below is displayed on screen.

In the **Configuration** tab, the following analysis parameters may be defined:



- **Wavelet** and **Parameters 1 and 2**: Select the wavelet family and its parameters. The wavelet shape is displayed in the view below and should be as close as possible to the signal shape.

- **Analysis window**: Block size, in number of points, on which each decomposition will be performed and on which denoising will be carried out over time.

- **Decomposition level**: The wavelet decomposition performs a multi-scale analysis by a two-fold undersampling at each decomposition step. By analogy with a filter bench, this means that with an analysis window of size 1024, two mirror low-pass and high-pass filters will be used to generate two daughter wavelets of 512 points and then the same procedure be carried out again on daughter wavelets (to the 9^{th} level maximum).

- **Conservation**: Select the percentage for energy saving.

An energy thresholding is performed on the lowest level daughter wavelets, by selecting only a defined percentage of wavelet coefficient. The lower energy components corresponding to the noise are thus deleted. The original signal is then rebuilt by applying reverse filters and interpolating ; thus yielding a signal including only the higher energy components.

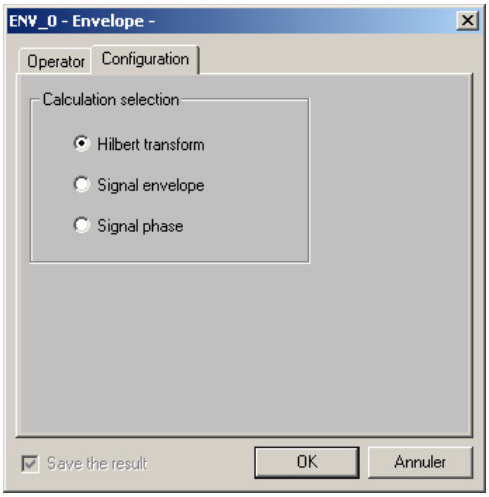
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**DENOIS_0**
Active for	**Signal, Impulse response families**
Restrictions	**Apply to one item only**
Results family	**Signal, Impulse Response**

4.6.2.16. Envelope operator

This processing calculates either the signal envelope or the analytical signal phase, or its Hilbert transform.

In the **Configuration** tab, the following analysis parameters may be defined:



- **Hilbert transform**: The Hilbert transform of the spectrum signal X(f) consists in building the spectrum signal X'(f) with: X'(f)=-j*sgn(f)

Performing a FFT on the original signal, then this operation and then a reverse FFT, yields a time signal, which is the Hilbert transform of the original signal.

The resulting signal is sometimes called a phase quadrature signal, as applying a Hilbert transform is equivalent to adding $\pi/2$ to the phase for positive frequencies and subtracting $\pi/2$ for negative frequencies.

Thus, the transform of $\cos(2\pi \times f0 \times t)$ is $\sin(2\pi \times f0 \times t)$.

Analytical signal:

- **Signal envelope and analytical signal phase**: The analytical signal of a time signal x(t) is a complex signal, the real part of which is x(t) and the imaginary part is the Hilbert transform of x(t).

The envelope x(t) is obtained by taking into account the module of this signal.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Envelope**
Default name	**ENV_0**
Active for	**1 Signal item**
Restrictions	**Applies for 1 item only**
Result family	**Signal**

4.6.2.17. Calculation of KB(t) and KBFm(t) signals

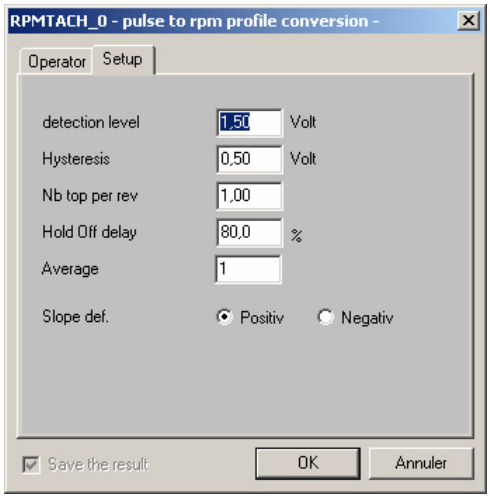
This processing calculates 3 items: KBF(t) signal, KBFTm(t) signal and max speed Vmax during measurement duration. The calculation used requirements of standard DIN 45669-1 (1995-06).

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**KB_0**
Active for	**1 Signal item**
Restrictions	**Applies for 1 item only**
Result family	**Signal**

4.6.2.18. Operator Pulse to RPM profile conversion [RPMTACH]

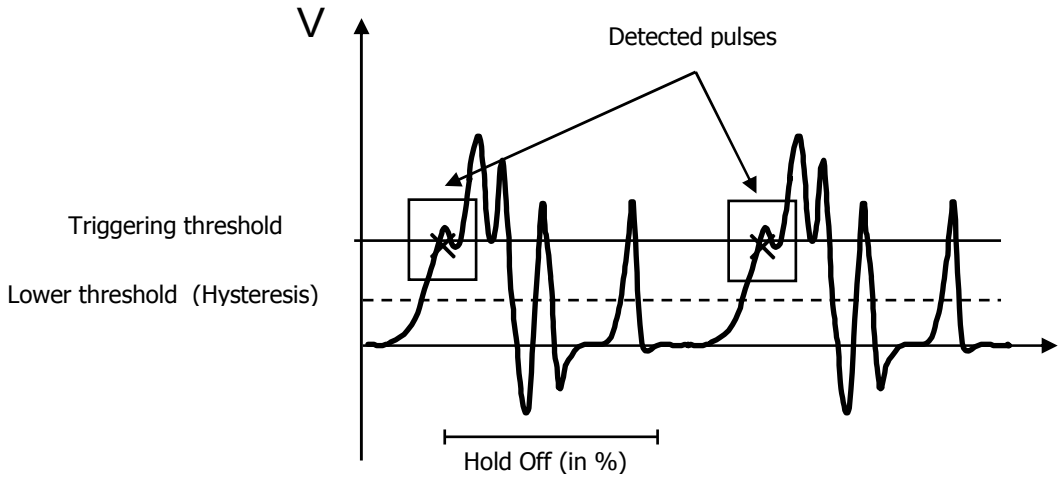
This operator is used to convert a tachometric signal acquired on a dynamic channel into a speed profile used for order analysis. The dialog box shown below is displayed on screen:



In the **Configuration** tab, the following analysis parameters may be defined:

- **Detection threshold**: Define the threshold value for pulse detection.
- **Lower threshold (Hysteresis)**: Define the lower threshold before reactivating the trigger for the pulse detection (case when the tachometric signal is of poor quality).
- **Number of pulse per revolution**: Specify the number of pulse per revolution.
- **Hold Off delay**: Define the time period during which the trigger is deactivated, as a percent of the time between the two previous triggers (case when the tachometric signal is of poor quality).
- **Averaging**: Define the number of items to average before calculating the speed.
- **Slope definition**: Define the signal slope for pulse detection.

Example: poor-quality signal



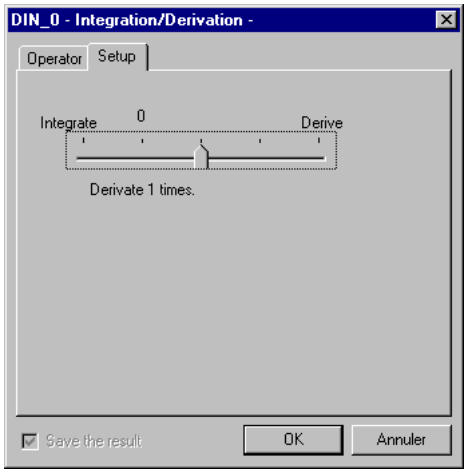
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**RPMTACH_0**
Active for	**1 Signal item**
Restrictions	**Applies for 1 item only**
Result family	**Speed profile**

4.6.2.19. Integration / Derivation operator [DIN]

This processing allows for the integration or the derivation of an acceleration, speed or displacement signal. The dialog box shown below is displayed.

In the **Configuration** tab, the following analysis parameters may be defined:



- **Integration / Derivation**: Use this field to integrate/derive signals.

Move the cursor to the left to integrate the signal once (first tick).

Move the cursor to the right to derive the signal once (first tick), twice (second tick) or three times (third tick).

The table below summarises the different integration/derivation options depending on the type of signal.

Data type		Integration	Derivation		
		1	1	2	3
Signal	m/s^2	m/s	m/s^3	x	x
	m/s	m	m/s^2	m/s^3	x
	m	x	m/s	m/s^2	m/s^3

Nomenclature:

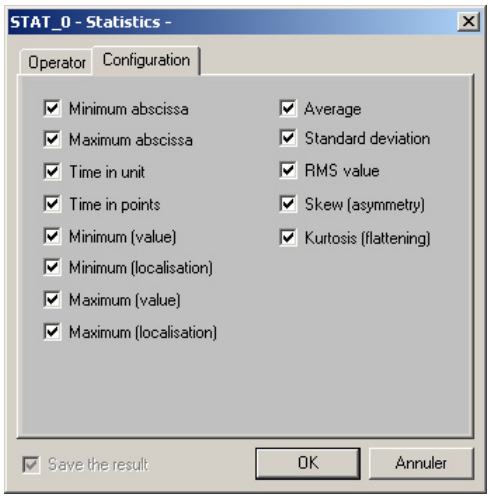
Jerk	m/s^3
Acceleration	m/s^2
Speed	m/s
Displacement	m

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Integration / derivation**
Default name	**DIN_0**
Active for	**Acceleration, speed, displacement signals**
Restrictions	**Applies to one item only** **The number of derivations or integrations should be compatible with dimension units**
Result family	**Jerk, acceleration, speed or displacement signals**

4.6.2.20. Statistics operator [STAT]

This function is used to calculate statistical indicators such as average, maximum, minimum, standard deviation and Kurtosis on a signal. The dialog box shown below is displayed on screen.



In the **Configuration** tab, the following analysis parameters may be defined:

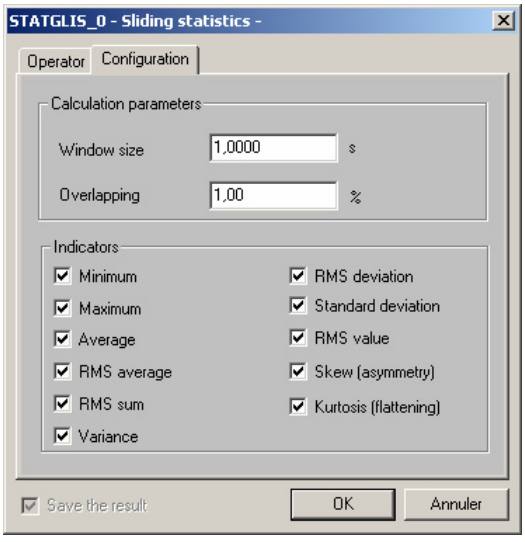
- Check the elements to calculate.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Statistics**
Default name	**STAT_0**
Active for	**Signals**
Restrictions	**Applies to 1 item**
Result family	**Results table**

4.6.2.21. Sliding statistics operator [STATGLIS]

This function is used to calculate statistical indicators such as average, maximum, minimum, standard deviation and Kurtosis on a signal with a sliding calculation window. The dialog box shown below is displayed on screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Window size**: Enter the duration of the indicator calculation window.
- **Overlap**: Enter the overlap factor for the calculation.
- **Indicators**: Check the elements to calculate.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator

Default script	**Sliding statistics**
Default name	**STATGLISS_0**
Active for	**Signals**
Restrictions	**Applies to 1 item**
Result family	**Signal; 1 item per index**

4.6.2.22.y=Ax+B Operator [AXB]

This operator performs y=Ax+B affine transform. It is used after an integration to add an offset.

The **Setup** tab allows to define A and B values. After an integration, choose A=1 and B=offset.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal Analysis**
Default name	**AXB_0**
Active for	**Signals**
Restrictions	**Applies to 1 item**
Result family	**Signals**

4.6.3. Operations on spectra

4.6.3.1. Theory

Various operations are possible on spectra:

- **Frequency recombination**

From spectra or multispectra, in narrow bands or in broad bands, it is possible to recombine spectra or multispectra with a lower frequency resolution.

The synthesis of a broad-band spectrum into another broad-band spectrum is classical. For example, the recombination of a third octave band spectrum into an octave spectrum is done by the energetic sum of the 3 third octave bands that would be part of an octave band.

For synthesis of a narrow-band spectrum into a broad-band spectrum, the energetic summation is allowed only if there is at least 5 narrow bands to sum, those lying in the frequency limits of the broad band.

- **Time recombination**

From multispectra in narrow bands or in broad bands, it is possible to perform various time operations:

- ❑ Recombination according to a greater time base
- ❑ Extraction of maximum, minimum and averaged spectra
- ❑ Extraction of an instantaneous spectrum, whose overall level satisfies a given criterion (minimum, maximum, weighted or not).

- **Integration/derivation**

Spectra in narrow bands (autospectra and cross-spectra), which physical unit that can be integrated or derived (jerk, acceleration, velocity, displacement), can integrated or derived according to the following formula (Y is the result, X is the input):

Derivation n times:

$$Y(f) = (j.2.\pi.f)^n X(f)$$

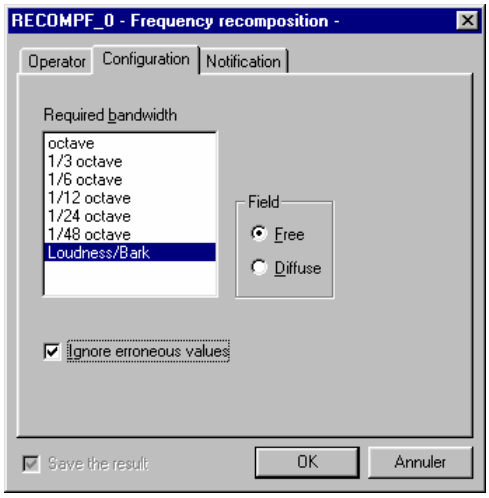
Integration n times:

$$Y(f) = \frac{1}{(j.2.\pi.f)^n} X(f)$$

A cross-spectrum that results from the computation of velocity and displacement spectra, for example, can therefore be integrated once for one quantity (velocity), and be derived twice for the other unit (displacement).

4.6.3.2. Frequency recomposition Operator [RECOMPF]

This analysis results in the recomposition of a broad band or narrow band multispectrum into a multispectrum of different frequency bandwidth. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Required bandwidth.** Select the octave sub-division of the spectrum to recompose.

For a frequency recomposition in Barks bands (with conversion to a Loudness level), give details on the type of sound field: **Free field** or **Diffuse field.**

If the box **Ignore erroneous values** is ticked, frequency bands that present erroneous values are still computed. There are not computed (no value) if the box is not ticked.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

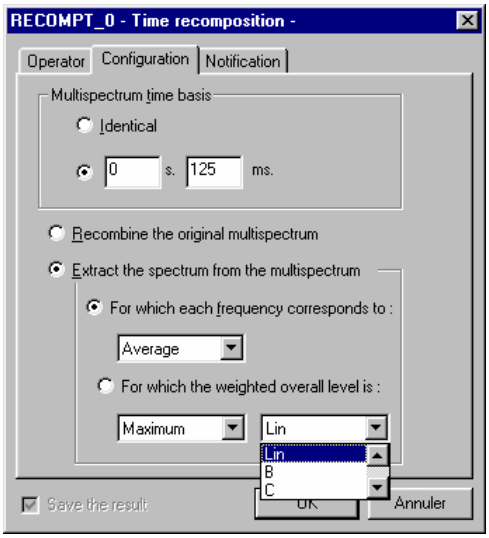
Default script	**Spectra operations**
Default name	**RECOMPF_0**
Active for	**Autospectrum, Intensity (active, free field, reactive)**
Restrictions	**Apply for one item only** **Narrow bands to Bark bands: a minimum of 5 narrow band values is required to synthesis a specific Loudness** **Broad band to broad band: the required bandwidth must be greater than the original bandwidth (e.g.: 1/6 octave spectrum recombine into an octave spectrum)**
Family of the result	**Autospectrum, Intensity (active, free field, reactive)**

4.6.3.3. Time recomposition Operator [RECOMPT]

This processing allows the user to recombine a broad-band or narrow-band multispectrum:

- either on a larger time basis (multiple of the initial time basis)
- or to calculate the minimum / maximum / average spectrum, from the multispectrum on the same different time basis or on a different one. The recomposition on a different time basis affects the minimum and the maximum extraction.
- Alternatively, to extract an instantaneous spectrum the overall level of which meets user-defined criteria, from the multispectrum and on a different time basis or not.

The following dialog box appears on-screen. In the **Configuration** tab, the following analysis parameters may be defined:



- **Multispectrum time basis**

Select the multispectrum time basis (identical or multiple of the original time basis) in order to recombine the multispectrum or extract a spectrum.

Two possibilities are then offered to the user:

- **Recombine the original multispectrum**

Select this option to recombine the original multispectrum according to a different time basis, multiple of the original time basis.

The result of the analysis is a narrow-band or broad-band multispectrum of greater time basis.

- **Extract a spectrum from a multispectrum**

Select this option to extract a spectrum from the multispectrum. The user may extract the following spectra:

- The **average, minimum** or **maximum** spectrum, for which each frequency correspond respectively to the average, minimum or maximum values of the multispectrum, from the multispectrum and on a previously defined time basis.
- The instantaneous spectrum for which the overall level is either the **maximum** or the **minimum, A, B, C or Lin** weighted level of the multispectrum, from the multispectrum and on a previously defined time basis.

📖 *The multispectrum time basis for the recombination must greater and a multiple of the original time basis.*

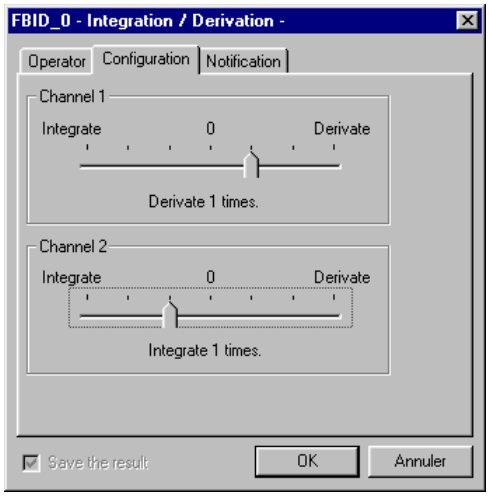
📖 *Extracting spectra can be done on a multispectrum with a different time basis as well. The time basis of the multispectrum will therefore greatly influence the result.*

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Spectra operations**
Default name	**RECOMPT_0**
Active for	**Autospectrum, Intensity (active, free field, reactive)**
Restrictions	**Apply for one item only** **Must be a multispectrum**
Family of the result	**Autospectrum, Intensity (active, free field, reactive)**

4.6.3.4. Integration / Derivation Operator [FBID]

This processing integrates or derives an autospectrum or a cross spectrum (acceleration, velocity, and displacement). The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Channel 1:** Use this field to integrate / derive autospectra and the first channel of cross-spectra.

Move the cursor to the left to integrate the spectrum once (first notch), twice (second notch) or three times (third notch).

Move the cursor to the left to derive the spectrum once (first notch), twice (second notch) or three times (third notch).

- **Channel 2:** Use this field to integrate / derive autospectra and the second channel of cross-spectra.

The table shown below lists the different possibilities of integration and derivation as a function of the physical unit of the data item:

Data items families		Channel 1						Channel 2					
		Integration			Derivation			Integration			Derivation		
		1	2	3	1	2	3	1	2	3	1	2	3
Autospectra	m/s^2	m/s	m	x	m/s^3	x	x	x	x	x	x	x	x
	m/s	m	x	x	m/s^2	m/s^3	x	x	x	x	x	x	x
	m	x	x	x	m/s	m/s^2	m/s^3	x	x	x	x	x	x
Cross-spectra	m/s^2	m/s	m	x	m/s^3	x	x	m/s	m	x	m/s^3	x	x
	m/s	m	x	x	m/s^2	m/s^3	x	m	x	x	m/s^2	m/s^3	x
	m	x	x	x	m/s	m/s^2	m/s^3	x	x	x	m/s	m/s^2	m/s^3

Legend:

Jerk	m/s^3
Acceleration	m/s^2
Velocity	m/s
Displacement	m

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Integration / derivation**
Default name	**FBID_0**
Active for	**Acceleration, velocity and displacement autospectra and cross-spectra**
Restrictions	**Apply for one item only** **The total number of derivations and integration must be compatible with the physical units of the data items**
Family of the result	**Jerk, acceleration, velocity and displacement autospectra and cross-spectra**

4.6.4. Frequency response functions

4.6.4.1. Theory

These operators allow the user to compute various transfer functions and associated cross-spectrum from two autospectra (Channel 1 and Channel 2) and a cross-spectrum. Each quantity is defined below:

- **Cross spectrum G21 (Gyx)**

The cross-spectrum Gyx of channels x and y is computed from the cross-spectrum Gxy by the formula:

Gyx = Gxy* then $G_{yx}(f) = 2.X(f).Y^*(f)$

Where Gxy* is the associated complex of Gxy (same real part, opposed imaginary part).

The modulus of the result, expressed in dB, is equal to :

$$10 \cdot \log_{10}\left(\frac{G_{yx}(f)}{X_{ref}.Y_{ref}}\right) = 10 \cdot \log_{10}\left(\frac{2.X(f).Y^*(f)}{X_{ref}.Y_{ref}}\right)$$

If the selected physical unit is not the IS unit, and if a conversion factor Cx is calculated (e.g.: Cx=9.81 for an acceleration level expressed in g), then the expression above becomes:

$$10 \cdot \log_{10}\left(\frac{G_{yx}(f)}{X_{ref}.Y_{ref}}.Cx.Cy\right)$$

The phase of the result, expressed in radians, is equal to:

The phase difference between spectra Yf) and X(f).

- **Frequency response function H1**

If x is the input signal and y the output signal of the process, the transfer function H1 is defined as:

$$Y(f) = H(f).X(f)$$

The analyser calculates only autospectra and cross spectra. The first method is then to multiply the above equation on both sides by the conjugated Fourier transform of X(f), i.e., X*(f). From the Gxy cross spectrum and the Gxx cross spectrum, one obtains an expression called H_1:

H_1 = Gxy / Gxx

The modulus of the result, expressed in dB, is:

$$20\log_{10}\left(\frac{|H_1|.X_{ref}}{Y_{ref}}\right)$$

$|H_1|$ is the module of the frequency response function.

If the selected physical unit is not the IS unit, and if a conversion factor Cx is calculated (e.g.: Cx=9.81 for an acceleration level expressed in g), then the expression above becomes:

$$20\log_{10}\left(\frac{|H_1|.C_y.X_{ref}}{C_x.Y_{ref}}\right)$$

The phase of the result, expressed in radians, is equal to:

The phase of the Gxy cross spectrum

- **Inverse frequency response function 1/H1**

If x is the input signal and y the output signal of the process, the inverse transfer function 1/H1 is defined from the cross-spectrum Gxy and the modulus of the autospectrum |Gxx|:

1/H1 = Gxx / Gxy.

The modulus of the result, expressed in dB, is equal to:

$$20\log_{10}(\frac{|1/H_1|.Y_{ref}}{X_{ref}})$$

$|H_1|$ is the modulus of the frequency response function.

The phase of the result, expressed in radians, is equal to:

The opposite of the Gxy cross spectrum phase

- **Frequency response function H2**

If x is the input signal and y the output signal of the process, the frequency response cross function is defined based on the cross spectrum Gxy and the autospectrum Gyy. This is obtained by multiplying each side of the initial equation for the frequency response function H(f) by the conjugated Fourier transform of Y(f), i.e., Y*(f). It is called H_2:

H2 = Gyy / Gyx

The modulus of the result, expressed in dB, is equal to:

$$20\log_{10}(\frac{|H_2|.X_{ref}}{Y_{ref}})$$

$|H_1|$ is the modulus of the frequency response function.

If the selected physical unit is not the IS unit, and if a conversion factor Cx is calculated (e.g.: Cx=9.81 for an acceleration level expressed in g), then the expression above becomes:

$$20\log_{10}(\frac{|H_2|.C_y.X_{ref}}{C_x.Y_{ref}})$$

The phase of the result, expressed in radians, is equal to:

The phase of cross spectrum Gxy or the opposite of the phase of cross spectrum Gyx

- **Inverse cross transfer function 1/H2**

If x is the input signal and y the output signal of the process, the inverse cross transfer function 1/H2 is defined as the cross-spectrum Gyx and the autospectrum Gyy:

$1/H_2 = Gyx / Gyy$

The modulus of the result, expressed in dB, is equal to:

$$20\log_{10}\left(\frac{|1/H_2|.Y_{ref}}{X_{ref}}\right)$$

$|H_2|$ is the modulus of the frequency response function.

The phase of the result, expressed in radians, is equal to :

The opposite of the phase of cross spectrum Gxy or the phase of Gyx

- **Coherence**

If x is the input signal and y the output signal of the process, the coherence is defined based on the cross-spectrum Gxy and the autospectra Gyy and Gyy. If γ is the coherence, then:

$\gamma^2 = |Gxy|^2 / [\ |Gxx| \ . \ |Gyy|\ ]$.

The coherence is a dimensionless number ranging from 0 to 1.

- **Other method for determining the frequency response function: transmissibility calculation**

By raising the initial expression of the frequency response function H(f) to the power of two, a new expression is obtained:

$|H_a|^2 = \frac{Gyy}{Gxx}$. This expression does not contain any phase information.

The modulus of the result, expressed in dB, is equal to:

$$10\log_{10}\left(\frac{|H_a|^2.X^2_{ref}}{Y^2_{ref}}\right)$$

$|H_a|$ is the modulus of the frequency response function.

📖 *This method for the determination of the frequency response function is not developed in **dBFA**.*

The order of selection of the items is important. It is necessary to select Gxx, then Gyy, then Gxy. If not, calculations are not applicable.

4.6.4.2. Cross spectrum G21 Operator [FBG21]

This processing produces, from a cross-spectrum, the cross-spectrum defined as its associated complex.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Frequency response functions**
Default name	**FBG21_0**
Active for	**Autospectrum Channel 1 + Autospectrum Channel 2 + Cross-spectrum Channel 1 - Channel 2**
Restrictions	**None**
Family of the result	**Cross-spectrum**

4.6.4.3. Frequency response function H1 Operator [FBH1]

This processing produces, from the autospectrum Gxx of the input signal and the cross spectrum Gxy between the input and the output, the frequency response function defined by Gxy / |Gxx|.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Frequency response functions**
Default name	**FBH1_0**
Active for	**Autospectrum Channel 1 + Autospectrum Channel 2 + Cross-spectrum Channel 1 - Channel 2**
Restrictions	**Check the compatibility of the physical units, the type of data, the weighting window, frequency and time resolution**
Family of the result	**Frequency response function H1**

4.6.4.4. Inverse frequency response function 1/H1 Operator [FBIH1]

This processing produces, from the autospectrum Gxx of the input signal and the cross spectrum Gxy between the input and the output, the transfer frequency response defined by |Gxx| / Gxy|.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Frequency response functions**
Default name	**FBIH1_0**
Active for	**Autospectrum Channel 1 + Autospectrum Channel 2 + Cross-spectrum Channel 1 - Channel 2**
Restrictions	**Check the compatibility of the physical units, the type of data, the weighting window, frequency and time resolution**
Family of the result	**Frequency response 1/H1**

4.6.4.5. Frequency response cross function H2 Operator [FBH2]

This processing produces, from the autospectrum Gyy of the output signal and the cross spectrum Gxy between the input and the output, the transfer frequency response defined by |Gyy| / Gyx..

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Frequency response functions**
Default name	**FBH2_0**
Active for	**Autospectrum Channel 1 + Autospectrum Channel 2 + Cross-spectrum Channel 1 - Channel 2**
Restrictions	**Check the compatibility of the physical units, the type of data, the weighting window, frequency and time resolution**
Family of the result	**Frequency response function H2**

4.6.4.6. Inverse frequency response cross function 1/H2 Operator [FBIH2]

This processing produces, from the autospectrum Gyy of the output signal and the cross spectrum Gxy between the input and the output, the frequency response function defined by Gyx / |Gyy|.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Frequency response functions**
Default name	**FBIH2_0**
Active for	**Autospectrum Channel 1 + Autospectrum Channel 2 + Cross-spectrum Channel 1 - Channel 2**
Restrictions	**Check the compatibility of the physical units, the type of data, the weighting window, frequency and time resolution**
Family of the result	**Frequency response function 1/H2**

4.6.4.7. Coherence Operator [FBCOH]

This processing produces, from the autospectra Gxx and Gyy of the input and output signals and the cross spectrum Gxy between the input and the output, the coherence defined by $Co^2 = [\ |Gxy|^2\ ] / [\ |Gxx|\ .\ |Gyy|\ ]$.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Frequency response functions**
Default name	**FBCOH_0**
Active for	**Autospectrum Channel 1 + Autospectrum Channel 2 + Cross-spectrum Channel 1 - Channel 2**
Restrictions	**Check the compatibility of the physical units, the type of data, the weighting window, frequency and time resolution**
Family of the result	**Coherence**

4.6.5. Arithmetic operations

These operators allow the user to add, subtract or average signal data, spectra and overall quantities.

For complex spectra (cross-spectrum, transfer function, coherence), only the averaging operator is available.

These operations can be performed according to two types of arithmetic rules:

- **Algebraic rule**

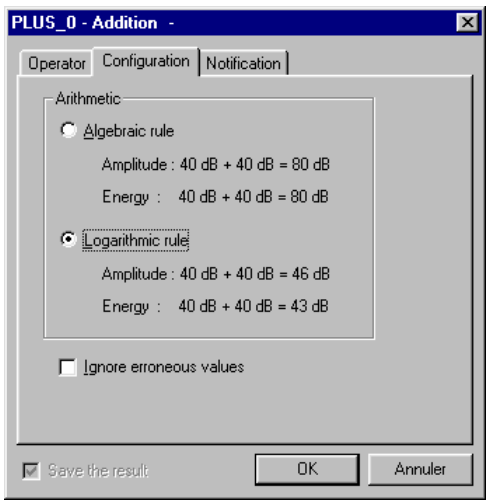
  For energy summation (spectra, overall quantities): **40 dB + 40 dB = 80 dB**
  For amplitude summation (signal) : **40 dB + 40 dB = 80 dB**

- **Logarithmic rule**

  For energy summation (spectra, overall quantities): **40 dB + 40 dB = 43 dB**
  For amplitude summation (signal): **40 dB + 40 dB = 46 dB**

4.6.5.1. Addition Operator [PLUS]

This processing sums up all the selected quantities. The user may choose either to perform an algebraic or logarithmic sum. The following dialog box appears on-screen.


PLUS_0 - Addition -
Operator
Configuration
Notification
Arithmetic
Algebraic rule
Amplitude : 40 dB + 40 dB = 80 dB
Energy : 40 dB + 40 dB = 80 dB
Logarithmic rule
Amplitude : 40 dB + 40 dB = 46 dB
Energy : 40 dB + 40 dB = 43 dB
Ignore erroneous values
Save the result
OK
Annuler

In the **Configuration** tab, the following analysis parameters may be defined:

- **Algebraic rule**

Select the algebraic rule for an algebraic summation of data items.

- **Logarithmic rule**

Select the logarithmic rule for an energetic summation of data items.

If the box **Ignore erroneous values** is ticked, frequency bands that present erroneous values are still computed. There are not computed (no value) if the box is not ticked.

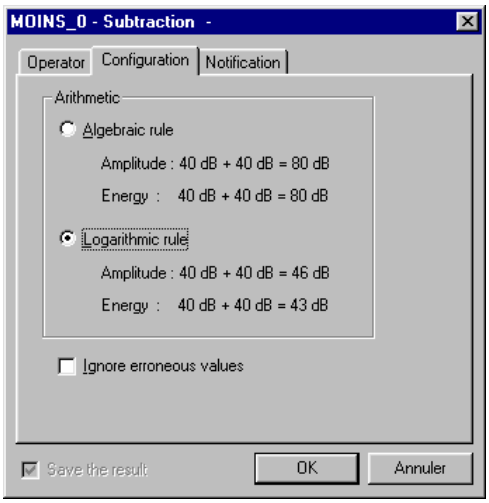
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Arithmetic**
Default name	**PLUS_0**
Active for	**At least 2 signals, autospectra, Leq (Leq, Peak, Slow, Fast, etc.).**
Restrictions	**If signals: same physical units, sampling frequency and references.** **If Leq: same physical units, time basis, references, type of data.** **If autospectra: same physical units, references, band width or resolution (narrow bands), time basis, type of data.**
Family of the result	**Signal, autospectrum, Leq (Leq, Peak, Slow, Fast, etc.)**

Loudness levels cannot be added.

4.6.5.2. Subtraction Operator [MOINS]

This processing subtracts all the selected quantities. The user may choose either to perform an algebraic or logarithmic subtraction. The following dialog box appears on-screen.


MOINS_0 - Subtraction -
Operator
Configuration
Notification
Arithmetic
Algebraic rule
Amplitude : 40 dB + 40 dB = 80 dB
Energy : 40 dB + 40 dB = 80 dB
Logarithmic rule
Amplitude : 40 dB + 40 dB = 46 dB
Energy : 40 dB + 40 dB = 43 dB
Ignore erroneous values
Save the result
OK
Annuler

In the **Configuration** tab, the following analysis parameters may be defined:

- **Algebraic rule**

Select the algebraic rule for an algebraic subtraction of data items.

- **Logarithmic rule**

Select the logarithmic rule for an energetic subtraction of data items.

If the box **Ignore erroneous values** is ticked, frequency bands that present erroneous values are still computed. There are not computed (no value) if the box is not ticked.

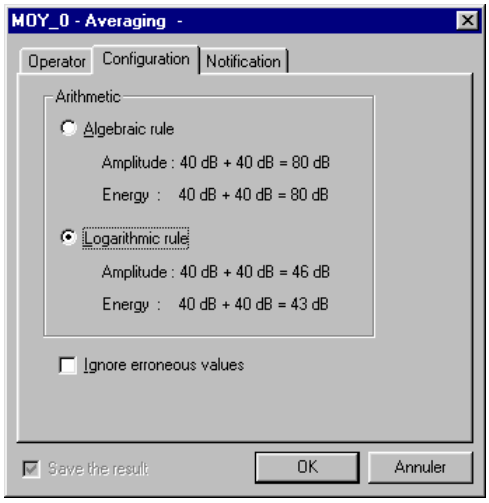
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Arithmetic**
Default name	**MOINS_0**
Active for	**At least 2 signals, autospectra, Leq (Leq, Peak, Slow, Fast, etc.).**
Restrictions	**If signals: same physical units, sampling frequency and references.** **If Leq: same physical units, time basis, references, type of data.** **If autospectra: same physical units, references, band width or resolution (narrow bands), time basis, type of data.**
Family of the result	**Signal, autospectrum, Leq (Leq, Peak, Slow, Fast, etc.)**

Loudness levels cannot be subtracted.

4.6.5.3. Averaging Operator [MOY]

This processing averages all the selected quantities. The user may choose either to perform an algebraic or logarithmic average. The following dialog box appears on-screen.


MOY_0 - Averaging -
Operator
Configuration
Notification
Arithmetic
Algebraic rule
Amplitude : 40 dB + 40 dB = 80 dB
Energy : 40 dB + 40 dB = 80 dB
Logarithmic rule
Amplitude : 40 dB + 40 dB = 46 dB
Energy : 40 dB + 40 dB = 43 dB
Ignore erroneous values
Save the result
OK
Annuler

In the **Configuration** tab, the following analysis parameters may be defined:

- **Algebraic rule**

Select the algebraic rule for an algebraic average of data items.

- **Logarithmic rule**

Select the logarithmic rule for an energetic average of data items.

If the box **Ignore erroneous values** is ticked, frequency bands that present erroneous values are still computed. There are not computed (no value) if the box is not ticked.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Arithmetic**
Default name	**MOY_0**
Active for	**At least 2 signals, autospectra, Leq (Leq, Peak, Slow, Fast, etc.). Complex spectra: cross-spectra, transfer functions, coherence**
Restrictions	**If signals: same physical units, sampling frequency and references. If Leq: same physical units, time basis, references, type of data. If spectra: same physical units, references, band width or resolution (narrow bands), time basis, type of data.**
Family of the result	**Signals, autospectrum, Leq (Leq, Peak, Slow, Fast, etc.) Complex spectra: cross-spectra, transfer functions, coherence**

Loudness levels cannot be averaged.

4.6.6. Time history of an overall quantity

There are two ways to estimate the time history of an overall quantity:

- **From a time signal**

  This operator allows the user to compute, from a Signal item, the Short Leq time history of time basis ranging from 5 milliseconds to 999 seconds. The overall level may be frequency weighted (A, Lin, B, and C) and / or time weighted according to:

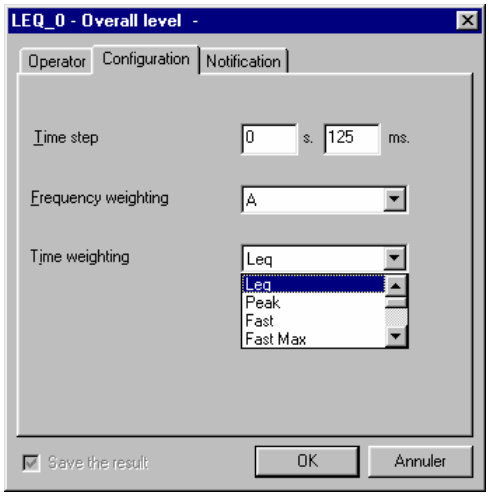
  - **Leq**: Classical short Leq time history
  - **Peak**: Time history of the maximum values of the signal over the item duration
  - **Fast**: Fast integration of the elementary short Leq
  - **Fast Min**: Time history of the minimum Fast values over the item duration
  - **Fast Max**: Time history of the maximum Fast values over the item duration
  - **Slow**: Slow integration of the elementary short Leq
  - **Slow Min**: Time history of the minimum Slow values over the item duration
  - **Slow Max**: Time history of the maximum Slow values over the item duration
  - **Impuls**: Impulse integration of the elementary short Leq
  - **Impuls Max**: Time history of the maximum Impulse values over the item duration

- **From a multispectrum**

These operators allow the user to perform a frequency recombination over a user-defined frequency range, with or without frequency weighting in order to calculate the time history of an overall level (frequency channel, overall level, Loudness, etc.). These processing functions apply to multispectra in narrow bands, broad bands and Bark bands.

4.6.6.1. Overall level Operator [LEQ]

This analysis results in a short Leqs time history of the time signal. Frequency (Lin, A, B, C) and time (Leq, Peak, Fast, etc.) weightings can be applied. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Time step**

This is the integration duration used to compute the overall level over the item duration. It varies from 1 ms to 999s

- **Frequency weighting**

Select the weighting to apply to the computed overall level: A, B, C, and Lin

- **Time weighting**

Select which time weighted overall level has to be computed: Leq, Peak, Slow, Slow Max, Slow Min, Fast, Fast Max, Fast Min, Impulse, Impulse Max

If, for example, a time step of 1 s is chosen for a 2 s long audio recording, only two values will be calculated (one value per second). The result will therefore be useless. It is recommended to specify as small a step as possible without increasing calculation time too much.

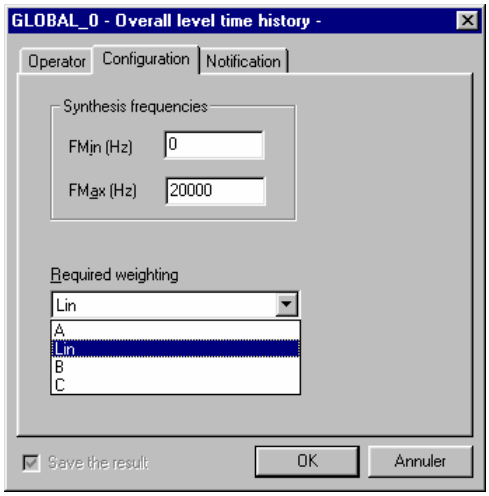
Excessive calculation time may cause problems if the computer has insufficient power. This should also be remembered with respect to the number of quantities and weightings involved in the calculation.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**LEQ_0**
Active for	**Signal, Impulse Response**
Restrictions	**Apply to one item only**
Family of the result	**Leq**

4.6.6.2. Overall level time history [GLOBAL]

This analysis results in the time history of the overall level of a multispectrum, with frequency weighting. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Synthesis frequencies**

Define the minimum and maximum frequency bands used to compute the overall level.

- **Required weighting**

Select the weighting to apply to the computed overall level time history: A, B, C, and Lin.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Spectra operations**
Default name	**GLOBAL_0**
Active for	**Autospectrum, intensity (active, reactive, free field)**
Restrictions	**Apply to one item of the type broad band or narrow band spectra only** **Narrow bands: require a common frequency range between the synthesis frequency range and the data item frequency range.**
Family of the result	**Leq**

4.6.6.3.Overall Loudness history Operator [BGLOBAL]

This processing yields the time history of the Loudness or the Sharpness for a Bark band spectrum. For a single spectrum, the result is an overall level. The dialog box below is displayed:

In the **Configuration** tab, the following analysis parameters may be defined:

- Select the magnitude to calculate.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**History of overall loudness**
Default name	**BGLOBAL_0**
Active for	**Bark spectrum**
Restrictions	**Applies to one item only**
Result family	**Overall (either time history or data table)**

4.6.7. Psychoacoustics

Various operators allows the user to compute psychoacoustic criteria:

- **Stationary criteria**

It is currently possible to measure the sound intensity of a noise event (in dB) and therefore quantify the nuisance level they may cause. Standard techniques however, are too simplistic to account for the subjective nature of human response to noise.

Psychoacoustics is a relatively new branch of psychophysics that addresses this problem. A number of parameters have been defined in order to take account of the subjective nature of human perception and judgement of sound quality:

- **Loudness, Loudness 10%**
- **Fluctuation Strength**
- **Sharpness**
- **Tonality**
- **Roughness**
- **Unbiased Annoyance** (a combination of Sharpness, Fluctuation Strength and Loudness 10%).
- **Sensory Pleasing Sound** (depends on Roughness, Sharpness, Tonality and Loudness criteria).

📖 *These criteria are defined in "Psychoacoustics: Facts and Models" by Zwicker and Fastl, Springer-Verlag, Ed.*

Furthermore, 3 types of **Articulation Indices** can be calculated:

- **NHV (Noise, Vibration and Harshness)** for the car industry.
- **Unikeller**, a variant of the Beranek method that does not have indices limited to the range 0~100%.
- **Rooms** generally used for offices and public places.

- **Loudness spectrum in Bark bands**

Digital filtering (24 filters) based on Butterworth filters of order 8, and for which the frequency limits correspond to the Bark bands.

- **Time history of Loudness and Sharpness criteria**

From a Loudness spectrum in Bark bands (intermediate computation done by the operator), the Bark bands are recombined to form the required criterion.

Before the presentation of each operator, let us present theoretically each psychoacoustic quantity.

4.6.7.1. Bark bands

In the field of acoustics, a third octave spectrum would usually be represented by narrow bands. However, this does not take into account the resolution frequency of the human ear. It is possible to divide the audible spectrum into 24 critical or so called, "bark" bands These have variable band widths in order to simulate human perception of sound more realistically. In addition, the 24-band format enables simplifications of the calculation process.

Values FMIN, FMAX and Fc of each Bark band are:

N°	FMIN	Fc	FMAX
1	20	50	100
2	100	150	200
3	200	250	300
4	300	350	400
5	400	450	510
6	510	570	630
7	630	700	770
8	770	840	920
9	920	1000	1080
10	1080	1170	1270
11	1270	1370	1480
12	1480	1600	1720
13	1720	1850	2000
14	2000	2150	2320
15	2320	2500	2700
16	2700	2900	3150
17	3150	3400	3700
18	3700	4000	4400
19	4400	4800	5300
20	5300	5800	6400
21	6400	7000	7700
22	7700	8500	9500
23	9500	10500	12000
24	12000	13500	15500

Conversion from Hertz to Barks is possible using the equation:

z in Bark and f in kHz :	

4.6.7.2. Stationary criteria

❑ **Loudness**

Loudness is a measure of sound energy and is expressed in *Sones*. It represents the intensity of the sound as perceived by the ear. As a reference, 1 sone is the level given by a pure sound of 1 kHz at 40 dB. This level increases by powers of two.

In this way, a relationship between the dB scale and sones may be established for 1 kHz. For the other frequencies, the sound level and frequency are altered to give the same feeling of Loudness. This method may appear user-dependent, however studies have shown considerable independence of this factor from the results.

The resulting Isosone graphs are made up of points corresponding to frequency levels that have equal Loudness obtained from pure sounds.

❑ **Fluctuation Strength**

The fluctuation strength concerns the sound models for frequencies f_{mod} perceived to be less than 20 Hz. The unit of Fluctuation strength is the vacil.

❑ **Sharpness**

The Sharpness of a sound describes the level of acuteness. It behaves in part as a barycentre weighting of the Bark band spectra. It is expressed in acum.

❑ Tonality

It allows to quantify tonal components in a spectrum of a signal by comparison of the Loudness level due to these components and the overall Loudness.

❑ Roughness

The Roughness criterion is used to identify the perturbing effect of mid-frequency modulation. It is expressed in Asper. It deals with sound level modulated in the range 20 Hz - 300 Hz.

❑ Unbiased Annoyance UBA

All the previous parameters give an indication on the nature of the noise and its perception by human experience. However; it would be interesting to be able to obtain a general description. Zwicker proposed a new parameter called **Unbiased Annoyance**.

The Unbiased Annoyance is a measure of how unpleasant the noise is perceived to be and is a combination of the previous parameters (Sharpness, Fluctuation Strength, and Loudness 10%).

❑ Sensory Pleasing Sound SPS

All the preceding parameters give an indication on the nature of the noise and its perception by human experience. However; it would be interesting to be able to obtain a general description. Zwicker proposed a new parameter called **Sensory Pleasing Sound**.

The Sensory Pleasing Sound is a measure of how pleasant the noise is perceived to be and is a combination of the previous parameters (Roughness, Sharpness, Tonality).

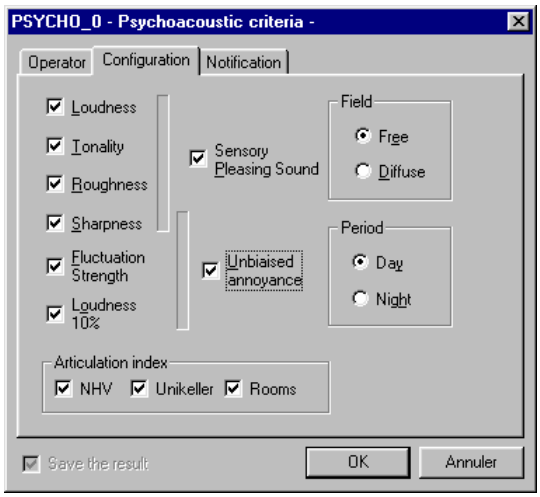
❑ Articulation index: Rooms, Unikeller, NHV

The articulation index aims to quantify the perception of fluctuating phenomena present in the studied noise. This index is expressed as a % where a high value indicates good audibility. Three main algorithms are used to calculate these articulation indices:

- The **Rooms** algorithm is used particularly for sound measurements in offices, rooms and public places in general.
- The **Unikeller** algorithm is a variation on the classic method developed by Beranek though here the indices are not limited to a scale ranging from 0~100%.
- The **NHV** algorithm (Noise, Vibration and Harshness) has particular relevance to the car industry.

4.6.7.3. Psychoacoustic criteria Operator [PSYCHO]

This analysis may result in the following stationary psychoacoustic criteria : Loudness, Loudness 10%, Fluctuation Strength, Sharpness, Tonality, Roughness, Unbiased Annoyance, Sensory Pleasing Sound, Articulation index. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

Tick the required boxes to calculate the corresponding psychoacoustic criteria.

Note that Sensory Pleasing Sound, Loudness, Tonality, Roughness and Sharpness criteria have to be computed as well.

The computation of the criteria Sensory Pleasing Sound also depends on the type of sound field (**free** or **diffuse**).

Note that the computation of the criteria Unbiased Annoyance, the Sharpness, Fluctuation Strength and Loudness 10% criteria have to be computed as well.

The computation of the criteria Unbiased Annoyance also depends on the time of the day (**day** or **night**).

The table shown aside is an example of results obtained after psychoacoustic analysis of an audio record.

Refer to the previous paragraphs for more details on each psychoacoustic criterion.

Psychoacoustic psy.cmg

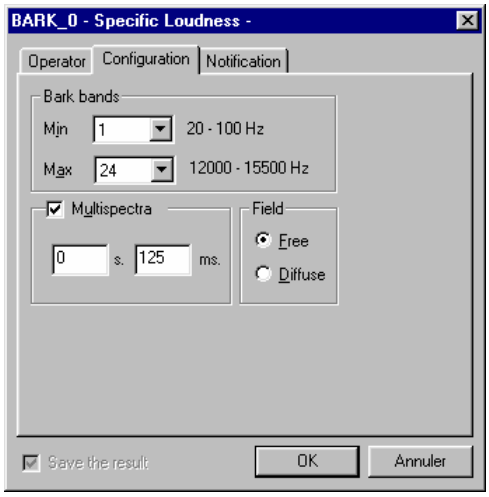
	27 (FD)	
Loudness	27.57	sone
Sharpness	1.04	acum
Fluctuation Strength	1.09	vacil
Tonality	0.00	tu
Roughness	8.34	asper
Unbiased Annoyance	258.03	au
Sensory Pleasing Sound	0.00	pu
Loudness 10%	56.85	sone
Articulation Index (NHV)	41.17	%
Articulation Index (Unikeller)	41.15	%
Articulation Index (Rooms)	57.00	%

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**PSYCHO_0**
Active for	**Signal, impulse response**
Restrictions	**Apply only for one item**
Family of the result	**Psycho**

4.6.7.4. Specific Loudness Operator [BARK]

This analysis results in a Bark band specific Loudness, with time history capability (specific Loudness multispectrum), a time step <= 50 ms is required for later psychoacoustic criteria computation. The result is expressed in sones, according to Zwicker B. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Bark bands**

Gives the minimum and maximum Bark bands used for computation of the overall Loudness level.

An indication of the frequency range covered by the analysis, for any given Bark band, is given.

- **Multispectra**

If this option is activated, the user obtains the time history of the spectrum over the item duration. The time step may vary from 1 ms to 999 seconds.

- **Field**

Select the type of sound field (**free** or **diffuse**) to compute the specific Loudness level.

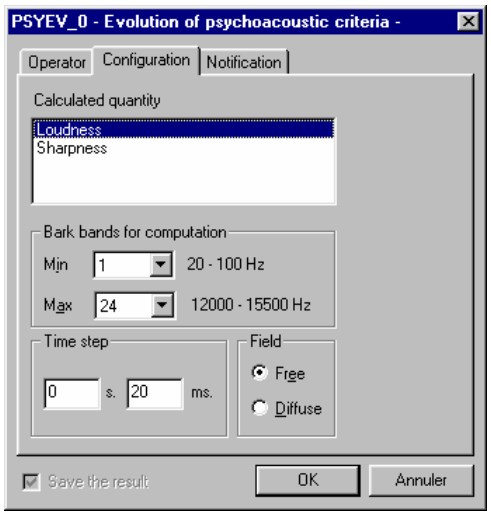
Note that this type of analysis is required in order to perform an analysis with the operator **Overall Loudness level time history**.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**BARK_0**
Active for	**Signal, impulse response**
Restrictions	**Apply only for one item**
Family of the result	**Bark spectrum**

4.6.7.5. Time history of psychoacoustic criteria [PSYEV]

This analysis results in the time history of psychoacoustic quantities : Loudness (Zwicker B), Sharpness. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Calculated quantity**

Select the psychoacoustic criterion for which the time history will be calculated : Loudness, Sharpness.

- **Bark bands for computation**

Gives the minimum and maximum Bark bands used for computation of the psychoacoustic criteria.

An indication of the frequency range covered by the analysis, for any given Bark band, is given.

- **Time step**

Select the integration time to calculate the time history. This time step may vary from 1 ms to 999 seconds

- **Field**

Select the type of sound field (**free** or **diffuse**) to compute the psychoacoustic criterion.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

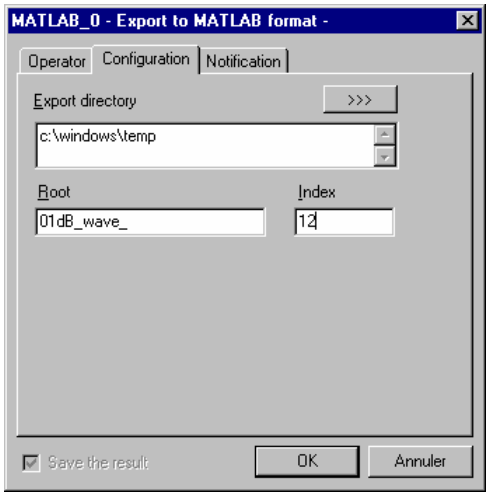
Default script	**Signal analysis**
Default name	**PSYEV_0**
Active for	**Signal, impulse response**
Restrictions	**Apply only for one item**
Family of the result	**Leq**

4.6.8. Exporting time signals

These operators are used to export audio events at the MATLAB format (*.MAT file, that can be directly processed into MATLAB with the "load" function) or the wave 01dB-Metravib format (*.WAV files) compatible with Windows.

4.6.8.1. Export to MATLAB format Operator [MATLAB]

This function exports the input quantity to the MATLAB format (.MAT file). This file can be directly processed into MATLAB with the "load" function. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Export directory**

Select a folder on the computer hard disk for storing the audio events that have been exported (MAT files).

The key >>> allows the user to browse the hard disk in order to find a specific folder.

- **Root / Index**

Select the root number for audio event exportation.
The type of the exported audio records will be root_index_number.MAT.

In the example above, the first record will be name 01db_wave_12.MAT, then 01db_wave_13.MAT, etc.

If a directory already contents exported records, select an index number higher than the maximum existing index in order to avoid overwriting records.

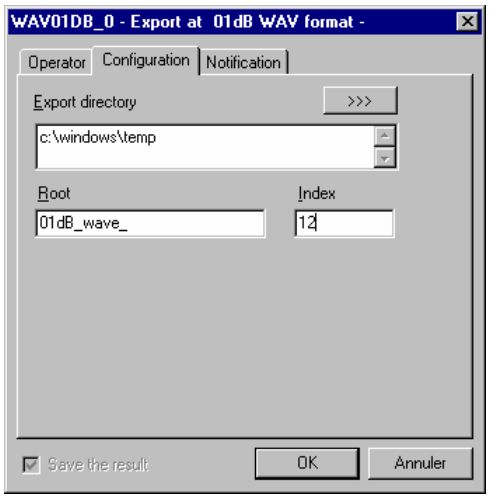
If using this operator in batch mode, the selection number of the item will be indicated in the file name.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Export**
Default name	**MATLAB_0**
Active for	**Signal families**
Restrictions	**none**
Family of the result	**x**

4.6.8.2. Export to 01dB-Metravib WAV format Operator [WAV01DB]

This processing exports the input quantity at the WAV 01dB-Metravib format (*.WAV file, Windows compatible). The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Export directory**

Select a folder on the computer hard disk for storing the audio events that have been exported (MAT files).

The key >>> allows the user to browse the hard disk in order to find a specific folder.

- **Root / Index**

Select the root number for audio event exportation.
The type of the exported audio records will be root_index_number.WAV.

In the example above, the first record will be name 01db_wave_12.WAV, then 01db_wave_13.WAV, etc.

If a directory already contains exported records, select an index number higher than the maximal existing one in order to avoid overwriting records.

If using this operator in batch mode, the selection number of the item will be indicated in the file name.

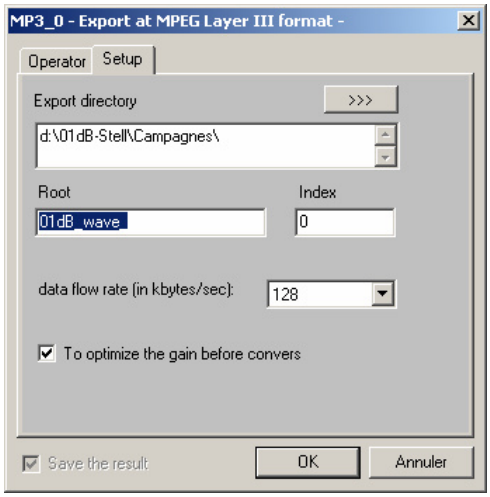
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Export**
Default name	**WAV01DB_0**
Active for	**Signal families**
Restrictions	**None**
Family of the result	**x**

4.6.8.3. Export to MP3 format operator [MP3]

This operation is used to export signal items in MPEG Layer III (MP3) format, which allows for data compression with no loss of quality during playback.
The exported signal (selected in a measurement session) must be sampled at **32 kHz** or **41 kHz**.
To export a signal sampled with a different frequency, use the resampling operator (see Section 14.6.2.10) before to obtain compatible signals.

Use the dialog box below to perform the exportation.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Export directory**

Select a directory on the hard disk where to export data.

The >>> button is used to browse the hard disk and search for a specific directory.

- **Root / Index**

Select the root name from which each record will be exported.

Exported records will be named root_index_number.MP3.

In the above example, the first exported record is named Demo1.MP3, the second, Demo2.MP3, and so on.

The index number is a way not to overwrite existing records previously exported in a directory.

In case of a multiple exportation (batch), the element selection number will be indicated in the filename.

- **Timing of the data flow**

Select the rate for the MP3 files in Kbytes/sec (by default: 128 Kbytes/sec).
The lower the rate, the smaller the created files (but possible quality loss).

The **Operator** tab provides a detailed description for the operating of this type of processing and can be used to modify its name.

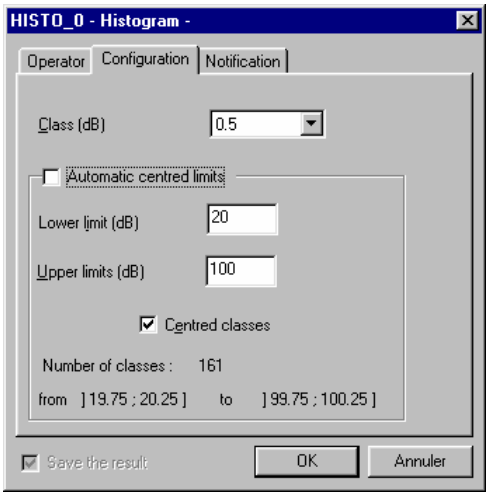
Default script	**Exportation**
Default name	**MP3_0**
Active for	**Signal families**
Restrictions	**none**
Result family	**x**

4.6.9. Operations on overall levels

From the time history of an overall quantity, it is possible to compute an histogram in dB, presenting the statistical distribution of the levels per class in %.

4.6.9.1. Histogram Operator [HISTO]

This processing produces a histogram of an overall quantity. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Class**

Select the class width (in dB) of the histogram to compute : 0.1dB, 0.5dB, 1dB, 5dB or 10dB.

- **Limits**

Select automatically or manually the lower and upper level limits (in dB) for the different classes of the histogram.

As a function of these limits and of the resolution of the histogram, the number of classes of the histogram is also given.

In manual mode (option **Automatic centred limits** not activated), it is possible to select or not the option Centred classes, for each class to be centred on an integer value of the dB levels.

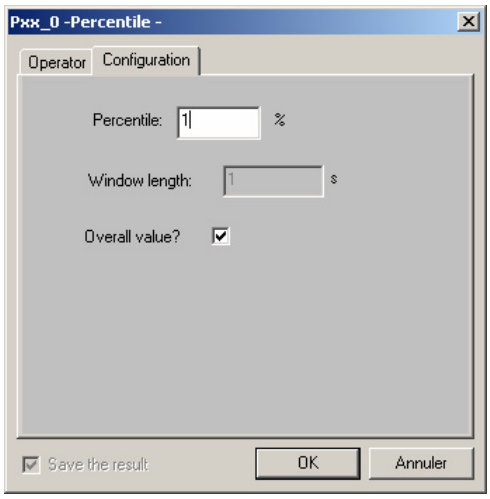
The lowest and highest classes are also given as an indication.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Histogram**
Default name	**HISTO_0**
Active for	**Leq (Leq, Peak, Fast, Slow, etc.)**
Restrictions	**Apply only for one item**
Family of the result	**Histo %**

4.6.9.2. Percentile Operator [Pxx]

This processing is a statistical calculation over the time history of overall levels, allowing for the calculation of the level reached or exceeded during x % of the time, either over the whole time history, or over a window size to define. The dialog box shown below is displayed on screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Percentile**: Enter the statistical index to calculate.
- **Window size**: length of the calculation window, which is going to move point by point.
- **Overall value?**: Check this box to obtain an overall index over the whole time history.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Percentile**
Default name	**Pxx_0**
Active for	**History of an overall level**
Restrictions	**Apply to one item only**
Results family	**Overall level or history of an overall level**

4.6.10. Room Acoustics

An operator is especially dedicated to room acoustics applications. From an impulse response acquired by MLS mode or by classical impulse technique, an echogram filtered in octave bands or third octave bands can be computed.

A specific operator used to compute commonly used room acoustics criteria (reverberation Time, Clarity, STI, etc.) is available in the dBBATI32 software package.

4.6.10.1. Echogram Operator [ECHOG]

This analysis results in an octave or third octave echogram. The following dialog box appears on-screen.

In the **Configuration** tab, the following analysis parameters may be defined:

- **Bandwidth** to define the spectrum bandwidth for the analysis: octave, 1/3 octave bands.
- **Min:** Minimum centre frequency of analysis in Hz.
- **Max:** Maximum centre frequency of analysis in Hz
- **Full octaves:** If this option is activated, the software will set the minimum and maximum frequency limits so that only full octaves are calculated.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**ECHOG_0**
Active for	**Signal, Impulse Response**
Restrictions	**Apply only to one item**
Family of the result	**Autospectrum**

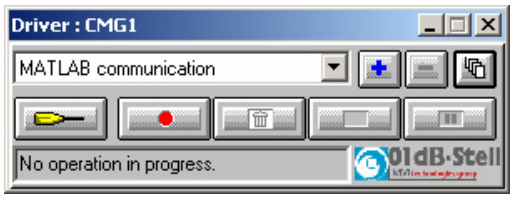
4.6.11. MATLAB connection operator [MATCO]

The MATLAB software holds today a leader position in scientific operating software thanks to its many tool boxes dedicated to very specialised domains like signal processing, image processing, neuronal network, automatism, etc.

A link in dBFA using the DCOM protocol allows the user to use MALAB as ActiveX server (automation server). That enables sending data (items of a dBFA measurement session) in the MATLAB workspace to use the specific display and/or processing functions. After having transmitted the data to MATLAB, the user has also the possibility to restore these data in dBFA and to modify them as a new item.

4.6.11.1. Use of Communication matlab operator

A dedicated script integrates this operator. When selecting an item which is MALTLAB operator compatible, the screen indicates the following dialogue box.

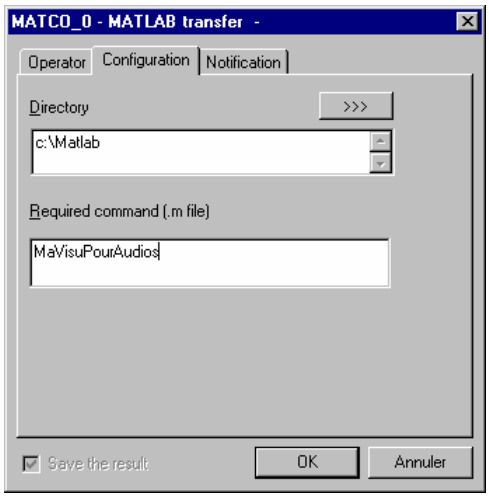


Note: the MATLAB communication script can group together several communication operators activated in parallel that works on the same inputs (batches).

In the following are the types compatible at the moment:

- **Type "SIGNAL"**: Signals, impulse response, static measurements, tachometric, etc.
- **Type "GLOBAL"**: Short Leq, history of the psycho-acoustic parameters, etc.
- **Type "Narrow band spectrum"**: Narrow band, real and complex spectra.
- **Type "Broad band spectrum"**: Fractional octave spectrum (1/1 to 1/48 octave)
- **Type "Bark band spectrum"**: Sound intensity/bark spectra

The script edition proposes the following interface:



The command files in .m format are familiar for all MATLAB users. These are text files which integrate a function that can be called directly from the MATLAB command window.

The 01dB-Metravib operator does the same: it proposes to the user to call a file function (normally the same name) with a list of fixed and pre-defined parameters that the MATLAB user has to respect.

The standard .m files are on the installation CD-ROM of 01dB-Metravib programs:
- **audio.m** for "signal" type items
- **leq.m** for "global" type items
- **fb.m** for "narrow band spectrum" type items
- **fc.m** for "broad band spectrum" type items
- **bark.m** for "bark band spectrum" type items

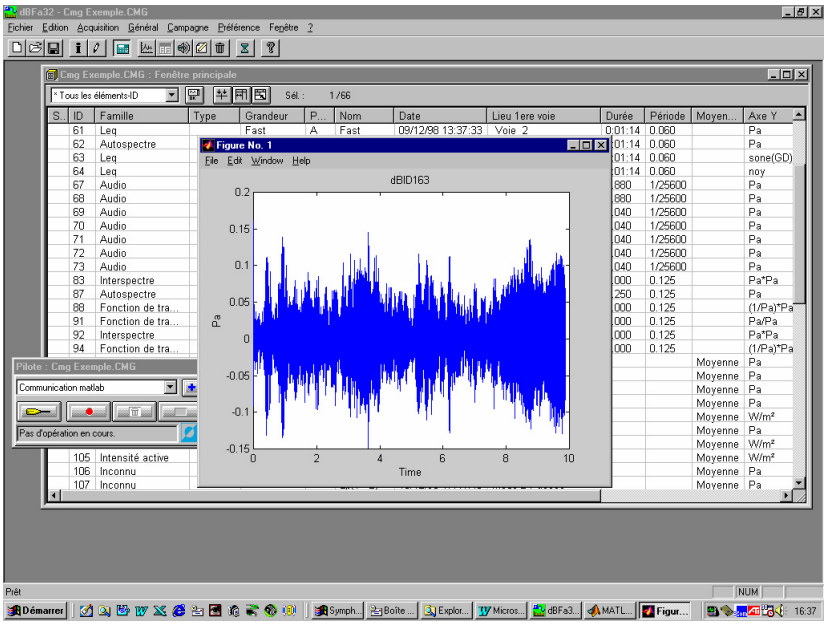
Copy the .m files in a directory on your hard disk, if using the MATLAB operator.
Then enter the directory path in the "Working directory " field of the dialogue box below.

Let us consider the .m file below, for **example**:

```
function MaVisuPourAudios(ID,nom,fe,unite)

figure;
nb=size(ID);
t=1:1:nb(1);
vect_t=t/fe;
plot(vect_t,real(ID));
xlabel('Time');
ylabel(unite);
title(nom);
```

With this file we display a "SIGNAL" type item of dBFA.
The activation of a script displays the MATLAB visualisation below in dBFA, for example.



We consider the argument list passed to the function:

ID
Name of the variable that shows the item selected as script input in dBFA in the MATLAB space. This identifier is created as follows: dB+n° where the number is the ID of the item in the dBFA measurement session.

Nom
Descriptive (string) of the item including the name (comments). Used here as figure title.

fe
sampling frequency of the item.

unite
string table that identifies the unit in which the quantity is expressed.

After this display and after deleting the item in dBFA, the variable remains valid in the MATLAB workspace. Only closing MATLAB or a clear command ('dBID6') will delete these data.

The MATLAB command window displays the list of available variables, if typing the command " who ".

" who
Your variables are:
dBID6
"

Then we can use this data as all MATLAB data.
As follows (maximal and averaged value), for example:

" max(dBID6)
ans =
0.1914
" mean(dBID6)
ans =
1.8266e-007
"

The file name .m is obviously free. Only the syntax is to respect (number of parameters and type).
All MATLAB errors are transferred to dBFA and indicated to the user, in case of a faulty syntax or an incorrect use of parameters

We change the MaVisuPourAudios file as follows, for example :

```
function MaVisuPourAudios(ID,nom,fe,unite,other)
figure;
nb=size(ID);
t=1:1:nb(1);
vect_t=t/fe;
plot(vect_t,real(ID));
xlabel('Time');
ylabel(unite);
title(nom);
```

The result is then :

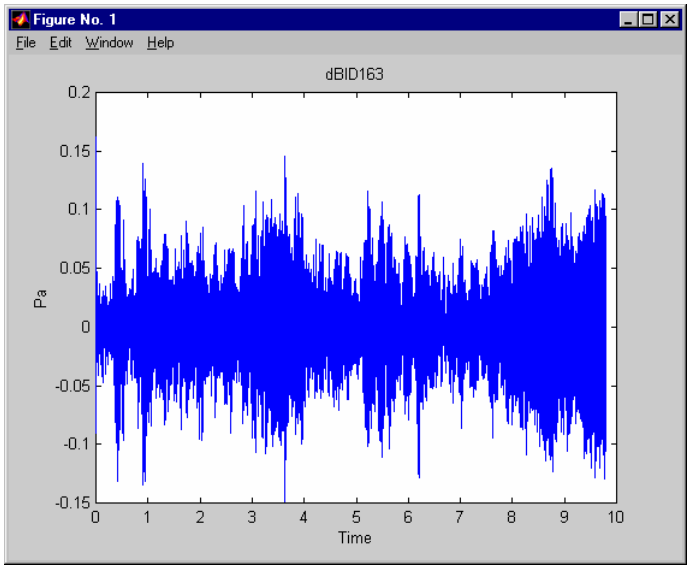
4.6.11.2. Type "SIGNAL"

Syntax
function xxx(ID, nom, fe,unite)
ID identifier of the variable: dBID+n°ID dBFA
nom name of the variable : ID(comment) (string)
fe sampling frequency
unite unit (string)

Example ("audio.m" file on CD-ROM):

```
function audio(ID,nom,fe,unite)
figure;
nb=size(ID);
t=1:1:nb(1);
vect_t=t/fe;
plot(vect_t,real(ID));
xlabel('Time');
ylabel(unite);
title(nom);
```

Result



4.6.11.3. Type "GLOBAL"

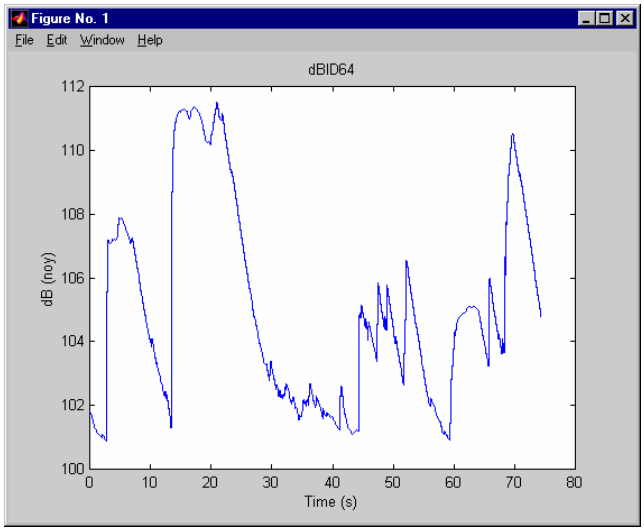
Syntax
function xxx(ID, nom, periode,unite)
ID identifier of the variable: dBID+n°ID dBFA
nom name of the variable : ID(comment) (string)
periode period (time step)
unite unit (string)

Note: ID is expressed in physical units and in energy

Example ("leq.m" file on CD-ROM):

```
function leq(ID,nom,periode,unite)
figure;
nb=size(ID);
t=1:1:(nb(1)+1);
ID(nb(1)+1)=ID(nb(1));
vect_t=(t-1)*periode;
stairs(vect_t,10*log10(ID/2e-5/2e-5));
xlabel('Time (s)');
yunit=sprintf('dB (%s)',unite);
ylabel(yunit);
title(nom);
```

Result



4.6.11.4. Type "BROAD BAND SPECTRUM"

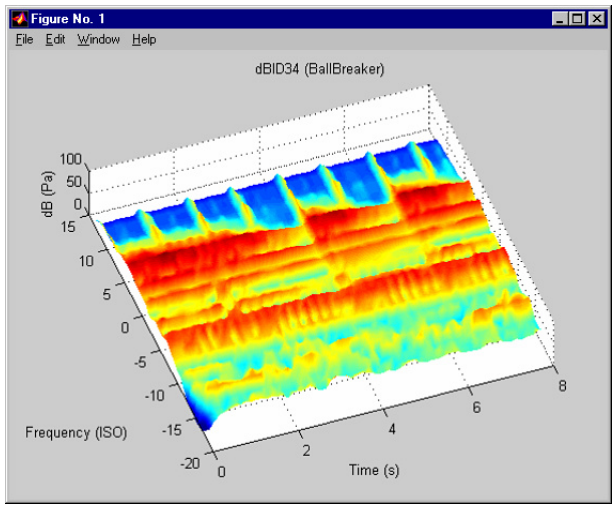
Syntax	
function xxx(ID, nom, fe,unite)	
ID	identifier of the variable: dBID+n°ID dBFA
nom	name of the variable : ID(comment) (string)
periode	period (time step)
imin	ISO index of the min band
partial	fractional octave (1,3,6,12,24,48)
unite	unit (string)

Note: ID is expressed in physical units and in energy

Example ("fc.m" file on CD-ROM):

```
function fc(ID,nom,periode,imin,partial,unite)
figure;
nb=size(ID);
t=1:1:nb(2);
f=1:1:nb(1);
vect_t=(t-1)*periode;
vect_f=imin+(f-1);
surf(vect_t,vect_f,max(10*log10(ID/2e-5/2e-5),0));
shading interp;
rotate3d;
xlabel('Time (s)');
ylabel('Frequency (ISO)');
aff=sprintf('dB (%s)',unite);
zlabel(aff);
view(0,90);
title(nom);
```

Result



4.6.11.5. Type "BARK BAND SPECTRUM"

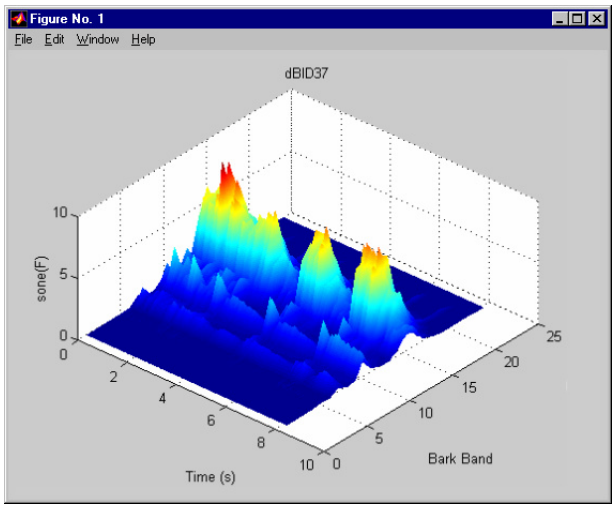
Syntax	
function xxx(ID, nom, fe,unite)	
ID	identifier of the variable: dBID+n°ID dBFA
nom	name of the variable : ID(comment) (string)
periode	period (time step)
imin	index of the min band (1 to 24)
unite	unit (string)

Note: ID is expressed in physical units and in energy

Example ("bark.m" file on CD-ROM):

```
function bark(ID,nom,periode,imin,unite)
nb=size(ID);
t=1:1:nb(2);
f=1:1:nb(1);
f=(f-1)+imin;
vect_t=(t-1)*periode;
surf(vect_t,f,max(ID,0));
shading interp;
rotate3d;
xlabel('Time (s)');
ylabel('Bark Band');
aff=sprintf('%s',unite);
zlabel(aff);
view(0,90);
title(nom);
```

Result



4.6.11.6. Type "NARROW BAND SPECTRUM"

Syntax
function xxx(ID, nom, fe,unite)

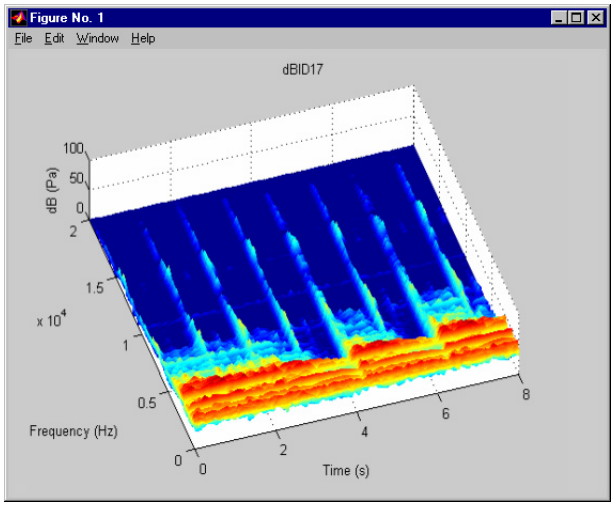
ID	identifier of the variable: dBID+n°ID dBFA
nom	name of the variable : ID(comment) (string)
periode	period (time step)
fmin	minimal spectrum frequency (Hz)
resolf	frequency resolution (Hz)
unite	unit (string)

Note: ID is expressed in physical units and in energy

Example ("fb.m" file on CD-ROM):

```
function fb(ID,nom,periode,fmin,resolf,unite)
figure;
nb=size(ID);
t=1:1:nb(2);
f=1:1:nb(1);
vect_t=(t-1)*periode;
vect_f=fmin+(f-1)*resolf;
surf(vect_t,vect_f,max(10*log10(ID/2e-5/2e-5),0));
shading interp;
rotate3d;
xlabel('Time (s)');
ylabel('Frequency (Hz)');
aff=sprintf('dB (%s)',unite);
zlabel(aff);
view(0,90);
title(nom);
```

Result



4.6.11.7. Type "COMPLEX NARROW BAND SPECTRUM"

Syntax
function xxx(ID, nom, fe,unite)

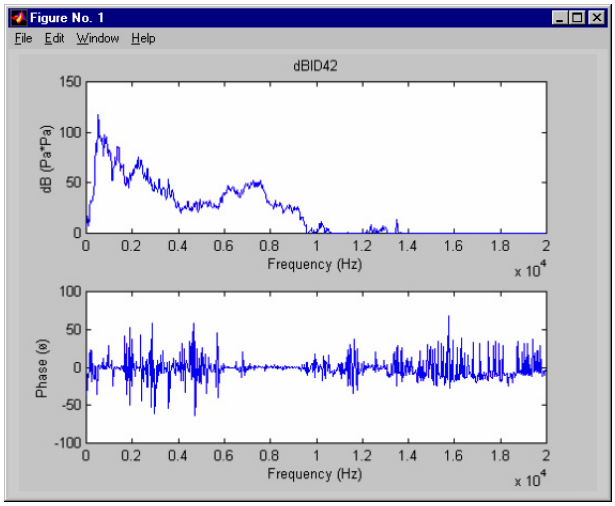
ID	identifier of the variable: dBID+n°ID dBFA
nom	name of the variable : ID(comment) (string)
periode	period (time step)
fmin	minimal spectrum frequency (Hz)
resolf	frequency resolution (Hz)
unite	unit (string)

Note: ID is expressed in physical units and in amplitude (complex spectrum).

Example (with averaged spectrum: period=0) ("fbc.m" file on CD-ROM):

```
function fbc(ID,nom,periode,fmin,resolf,unite)
figure;
nb=size(ID);
f=1:1:nb(1);
vect_f=fmin+(f-1)*resolf;
subplot(2,1,1);
plot(vect_f,max(20*log10(abs(ID)/2e-5/2e-5),0));
xlabel('Frequency (Hz)');
aff=sprintf('dB (%s)',unite);
ylabel(aff);
title(nom);
subplot(2,1,2);
plot(vect_f,angle(ID)*180/3.1415);
xlabel('Frequency (Hz)');
ylabel('Phase (ø)');
```

Result



4.6.11.8. Import Matlab results in dBFA

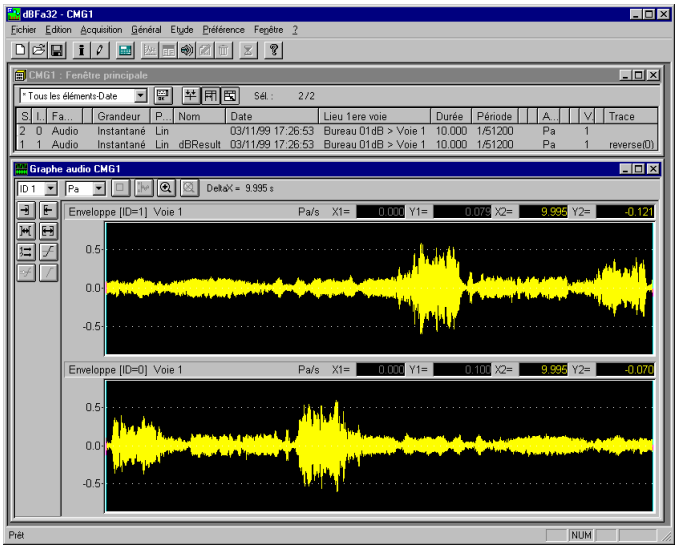
The MATLAB communication operator is also used to import MATLAB data in dBFA.
Therefor it is enough to modify the audio file .m (called **reverse .m**) as follows:

```
function ret=reverse(ID,nom,fe,unite)
nb=size(ID);
global dBResult;
dBResult=ID(nb(1):-1:1);
ret=1;
```

Required modifications:
The function has now a return variable: ret.
The function defines in its code a global variable called dBResult (fixed name).
A test will be carried out on the return value of the function after the start of the MATLAB reverse function.
The MATLAB operator import automatically a variable called dBResult as an item in the measurement session.

CONSTRAINT:
dBResult has to have the same dimension as the ID input.

This one allows the user to dedicate treatments in MATLAB that are not proposed in dBFA.
The Reverse function is used to get the mirror of a signal, for example.
The name of the new item is " dBResult " and it has the path of the operator.



4.6.11.9. Notes

Start MATLAB
The first script activates the application, if MATLAB is not already active. The following scripts will use the same proceedings.
You have to use the matlab.exe /Automation command in your Windows shortcut, if you want to start MATLAB before dBFA it starts.
Started in this way dBFA will use the MATLAB application already activated.

MATLAB recording as ActiveX server
Start the matlab.exe /RegServer command the first time.

Using batches
Thanks to the dBFA batches you can study systematically your signals with the MATLAB function .m. At the end of the batch you get you results in dBFA if needed.

4.6.12. Tachometry

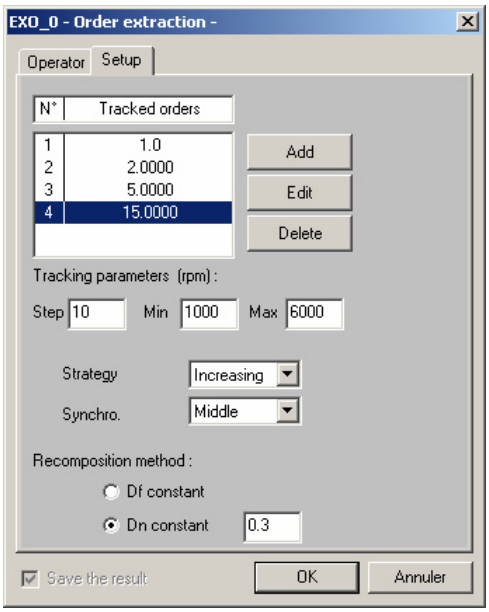
These operators are used to carry out various post-processing operations on signals coupled to speed profiles or to a dynamic acquisition channel of the tachometric signal:

- order extraction,
- order extraction with phase information,
- order filtering on a time signal,
- detection of cycle defects.

The order of selection of the items is important. It is necessary to select Signal, then Speed profile (or Pulse/rev). If not, calculations are not applicable.

4.6.12.1. Order extraction operator [EXO_0]

This operator performs order extraction from a speed channel and a measurement channel (selection of the method: constant resolution in order or in frequency).



In the **Configuration** tab, the following analysis parameters may be defined:

- **Tracked orders**: Enter the orders to extract from the analysis. Orders may be non integers.
- **Tracking parameters**: Define the speed interval between two FFT spectra calculation. Enter the minimum and the maximum speed for the analysis.
- **Strategy**: Indicate whether it is a run up (Increasing) or a run down (Decreasing).
- **Block Synchro**: Indicate if the speed used to date the spectrum is that at the beginning, at the middle or at the end of the analysis time block.

- **Recomposition** method: Define which frequency band will be used for the energy calculation of orders.

Df constant: the frequency band used to calculate the order will be a band with a constant width of Df.
Dn constant: the frequency band used to calculate the order energy will be a frequency band proportional to the speed, increasing with the frequency (Df = Dn × Speed/60, with Speed in rpm).

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

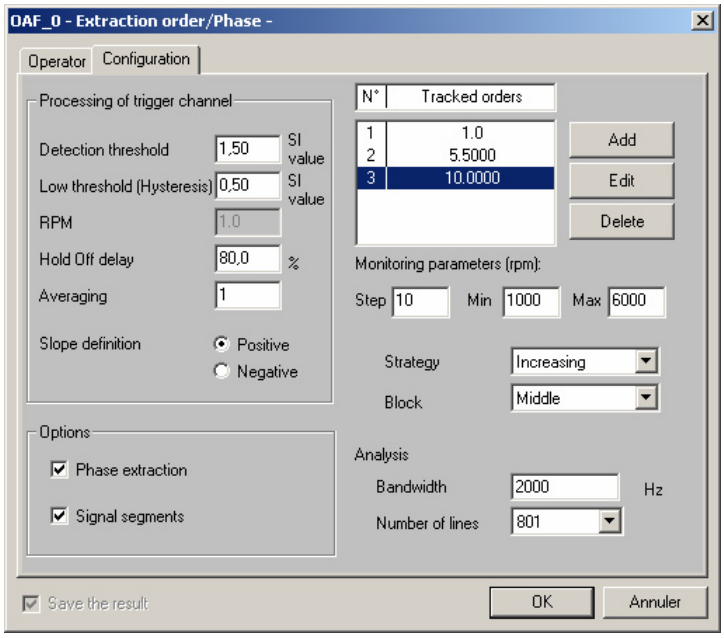
Default script	**Signal analysis**
Default name	**EXO_0**
Active for	**Signal + Speed Profile families**
Restrictions	**Items must belong to the same measurement**
Result family	**Overall/RPM; Autospectrum**

4.6.12.2. Order/Phase Extraction [OAF_0]

This operator performs an order extraction from a Signal item and a Tacho item (resulting from the recording of a tachometric transducer on a dynamic channel). This operation yields:

- A multispectrum versus speed or time containing phase information,
- An overall level per extracted order versus speed or time,
- An item containing information on the phase per extracted order.

In the **Configuration** tab, the following analysis parameters may be defined:



Management of the trigger input channel

- **Detection threshold**: Define the threshold value for impulse detection.
- **Lower threshold (Hysteresis)**: Define the lower threshold that the signal must pass to reactivate the trigger for impulse detection (case of a poor-quality tachometric signal).
- **Number of impulse / revolution**: Indicate the number of impulse per revolution.
- **Hold Off delay**: Definition of a time period during which the trigger is deactivated, as a percent of the time between the two previous triggerings (case of a poor-quality tachometric signal).
- **Averaging**: Define the number of elements to average before speed calculation.
- **Slope definition**: Define the signal slope for impulse detection.

Tracked orders: Use this table to add, delete or modify orders to extract. Orders may be non integers.

Tracking parameters (rpm): Define either the speed interval between two FFT spectra calculation (in that case, enter the Input minimum and maximum speed for analysis) or the time interval (in that case, enter the minimum and maximum time for the analysis).

- **Strategy**: Indicate whether it is a run up (**Increasing**) or a run down (**Decreasing**).
- **Block Synchro**: Indicate if the speed used to date the spectrum is that at the beginning, at the middle or at the end of the analysis time block.

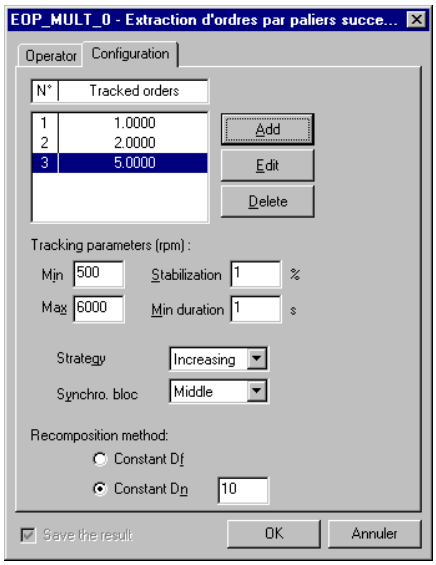
Analysis: Enter the bandwidth (in Hz), as well as the number of lines for the calculation.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Phase/order extraction**
Default name	**OAF_0**
Active for	**Signal family + Trigger family**
Restrictions	**Items should belong to the same measurement**
Result family	**Complex spectrum; Overall/RPM; Measurement/RPM; Signal**

4.6.12.3. Order extraction by successive levels Operator [EOP_MULT]

This processing carries out, from a speed profile channel and a measurement channel, the order extraction with method choice (constant resolution in order or in frequency). The extraction is performed by successive levels, for stabilized values of the speed.



In the **Setup** tab, the following analysis parameters may be defined.

- **Tracked orders** : Add orders to extract. Orders can be non-integer
- **Tracking parameters** : Define the speed interval between two FFT spectra calculation. Input minimum and maximum speed of the analysis.
- **Strategy** : Indicate if it is a slowdown (decreasing) or a revving up (increasing)
- **Synchro** : Define how to synchronize the results with the rpm values: beggining, middle or end **Recomposition method** : Define recomposition width. Expressed in frequency (if recomposition in Delta F) or in order (if recomposition in Delta N).

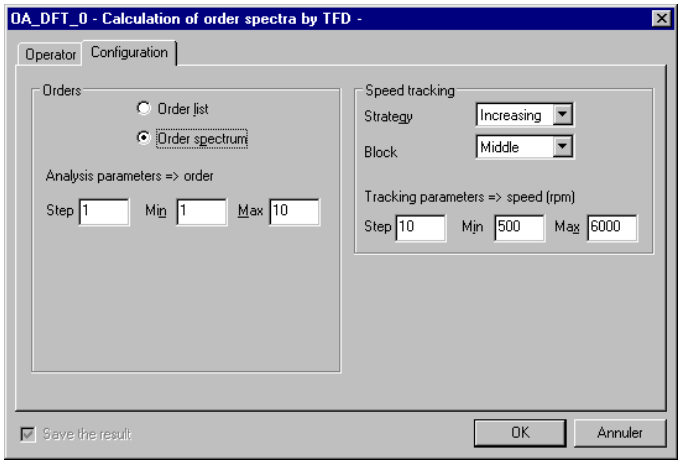
In DeltaF, the minimum width of recomposition is given by the Frequency resolution.
In DeltaN, the minimum width is given by: [Frequency resolution] / [RpmMin/60], RpmMin being defined in the parameters of the tachometric channel.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**EOP_MULT_0**
Active for	**Signal + Speed profile families**
Restrictions	**Items should belong to the same measurement**
Result family	**Global/RPM; Autospectrum**

4.6.12.4. Calculation of order spectra by TFD Operator [OA_DFT]

From a speed channel and a measurement channel, this processing calculates order spectra by discrete Fourier transform.



In the **Setup** tab, the following analysis parameters may be defined.

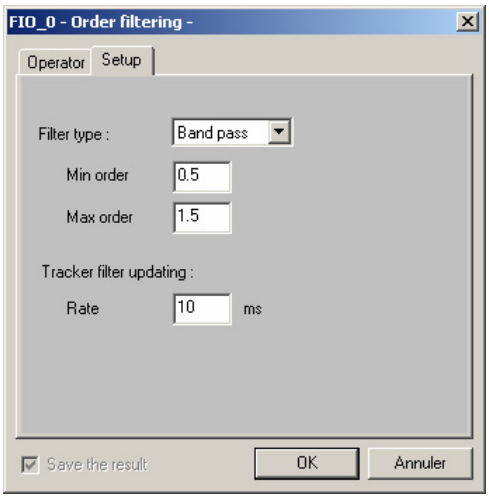
- **Orders** : Add orders to extract. It can be an order list, or an order spectrum (the list of calculated orders ranges from 1st Order to Last order with a Step Order. The maximum order allowed depends on the maximum speed studied and on the sampling frequency. Orders can be non-integer.
- **Tracking parameters** : Define the speed interval between two FFT spectra calculation. Input minimum and maximum speed of the analysis.
- **Strategy** : Indicate if it is a slowdown (decreasing) or a revving up (increasing).
- **Synchro** : Define how to synchronize the results with the rpm values: beggining, middle or end

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**OA_DFT_0**
Active for	**Signal + Speed profile families**
Restrictions	**Items should belong to the same measurement**
Result family	**Global/RPM; Autospectrum**

4.6.12.5. Order filtering operator

This operator uses an order tracking time filter from a speed channel. Filter characteristics (min/max order), as well as tracking timing, are user-defined.



In the **Configuration** tab, the following analysis parameters may be defined:

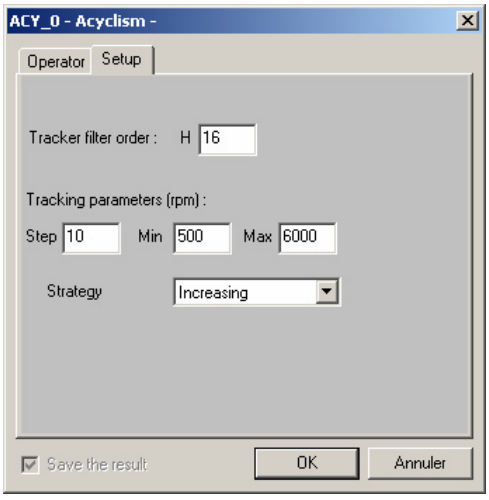
- **Filter type**: Define the type of filtering to perform (low pass, high pass, band cut, notch).
- **Min/max order**: Define the frequency ranges used by the filter.
- **Tracking filter update**: Define the time interval for tracking filters.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**FIO_0**
Active for	**Signal + Speed profile families**
Restrictions	**Items should belong to the same measurement**
Result family	**Signal**

4.6.12.6. Cycle defect operator

This operator is used to characterise cycle defects with respect to a reference tachometric channel and to calculate statistical magnitudes on amplitudes versus speed.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Tracking filter order**: Enter the order of the low-pass tracking filter.
- **Tracking parameters**: Enter the speed range to analyse, as well as the analysis step in rpm.
- **Strategy**: Indicate whether it is a run up (**Increasing**) or a run down (**Decreasing**).

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	**Signal analysis**
Default name	**ACY_0**
Active for	**Signal + Speed profile families**
Restrictions	**Items should belong to the same measurement**
Result family	**Signal**

5. BATCH PROCESSING

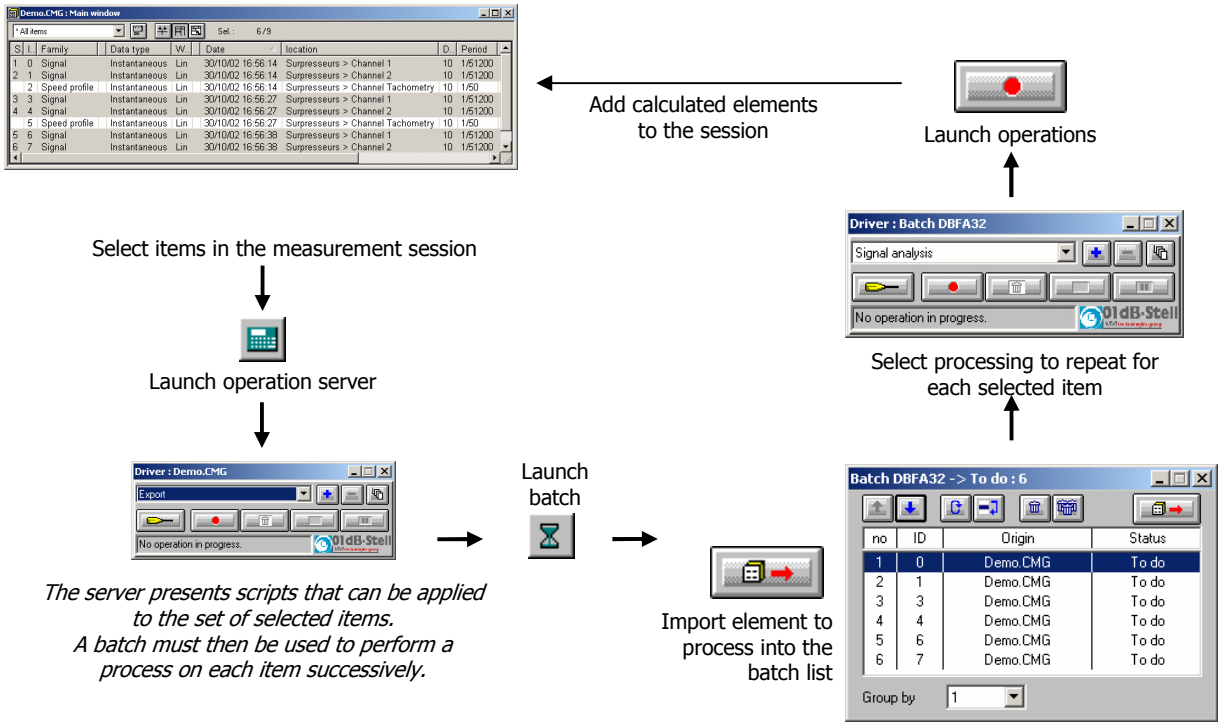
5.1. Overview

This chapter deals with the new capability of 01dB-Metravib software packages to launch a batch processing for a set of data items.

For example, if the user wishes to apply the same analysis script for a set of signal items contained in a measurement session file, it is possible to define a set of input quantities and to apply the script automatically input by input.

5.2. Summary

The procedure for using batch scripts is summarised in the scheme below.

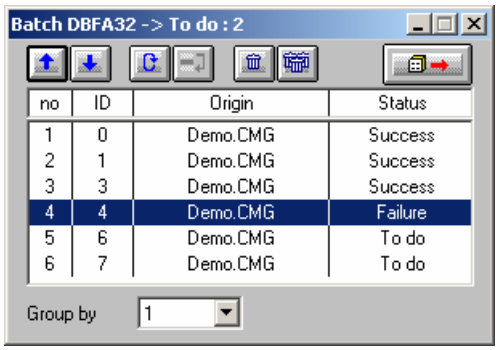

Add calculated elements to the session
Launch operations
Select items in the measurement session
Launch operation server
Select processing to repeat for each selected item
Launch batch
The server presents scripts that can be applied to the set of selected items.
A batch must then be used to perform a process on each item successively.
Import element to process into the batch list
Driver : Batch DBFA32
Signal analysis
No operation in progress.
Driver : Demo.CMG
Export
No operation in progress.
Batch DBFA32 -> To do : 6
no
ID
Origin
Status
Group by

Complete procedure

- **Select items** to process in the measurement session.
- (or **Main Menu / Operation server**) to open the server and display the window below.

The server displays the scripts that can be applied to the set of selected items. No set-up is required here for the time being since we will perform a processing **on each item successively**. A batch processing will then be used.

- (or **Session Menu / Batches**) to launch the batch processing window shown opposite.


Batch DBFA32 -> To do : 2
no ID Origin Status
1 0 Demo.CMG Success
2 1 Demo.CMG Success
3 3 Demo.CMG Success
4 4 Demo.CMG Failure
5 6 Demo.CMG To do
6 7 Demo.CMG To do
Group by 1

- Import selected items to the measurement session.
- The following function are available:

Sort the items for analysis.

Reset the batch. The status of all signal items switches to "To process".

Deactivate processing for selected item (status becomes "inactive").

Delete selected item from the batch.

Delete all items from the batch.

"Group by" : Grouping items is useful when performing a batch analysis with a script calculating a cross spectrum (i.e., requiring 2 Signal items for input), a transfer function (group of 3 relevant items) or an averaging, etc.

If the number of items to process is not a multiple of the group size, the last items becomes inactive in the batch (it will not be processed).

- The script server lists **all available scripts** to process batch items.

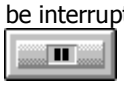
The title bar should read: **Driver: dBFA batch**.
Select the processing to perform on each group in the batch.

Refer to **Chapter 4.2** for more information on the operation server.

- Launch processing

- The operation window is as follows:

The progress of the processing on each item is displayed, along with its origin (target session) and its identification number in the session.
The number of items remaining to process is listed in the title bar.

The batch may be interrupted at any time by acting on script server.
Interrupting () and aborting ( ) have the same consequence: the batch processing is definitively stopped.

- Calculated items are automatically added to the session.

Working on several sessions

A batch may contain items originating from several sessions, in which case a source session must be selected when importing item into the batch ("Source session" window). This selection is repeated for each importation using .

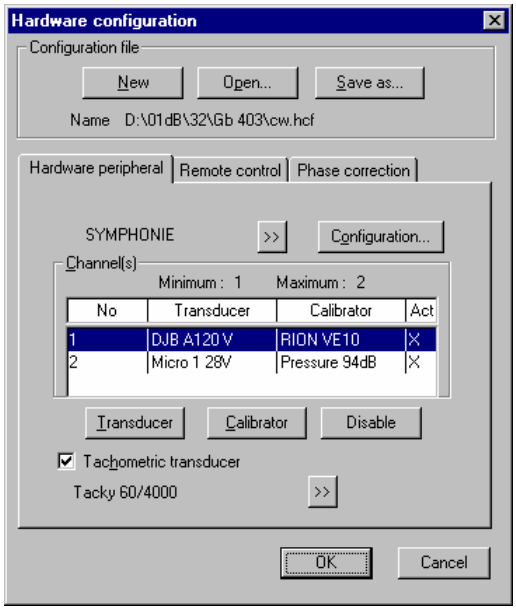
At the end of the processing, a "Target session" window is displayed in order to select the session to which all items will be exported.

The batch being a way to automate a processing, selecting a target session will not disturb the current calculations. All calculated items in a batch will be exported to a single session.

6. MEASUREMENT HARDWARE CONFIGURATION

This chapter concerns only intensity and Sound power (ISO9614) modes.

Hardware specification and settings are required before any measurement. The **Hardware configuration** option is found under the **Acquisition** menu of **dBFA** main window. This dialog box (see below) features various tabs: **Hardware Peripheral** is used to define which hardware elements are used to perform an acquisition (hardware peripheral, transducers, calibrators, active channels), **Remote control** is used to define and configure a remote control object (this tab is displayed only if the file DBCD32.INI is present in the 01dB-Metravib program files directory), **Phase correction** is used to select a sound intensity probe calibration data file (file extension *.AU) and Robot tab is used to configure the use of a rotating arm for example.



From the **hardware peripheral** tab, define:

- The type of hardware platform
- The active measurement channels
- For each channel, a couple transducer / calibrator of same type
- The signal conditioning options of the selected hardware peripheral (**Configuration** key)

The hardware configuration defined here will be recalled automatically next time the program is used.

The acquisition platforms, transducers and calibrators are selected from hardware elements' databases defined under the hardware configuration programme **dBCONFIG.**

📖 *Selection, use and configuration of remote controls are dealt with in **chapter 10**.*

- **Hardware**

The hardware board configuration sets up the computer so that it will be able to record data generated by the specified board. It sets the number of possible active channels. The Configuration key gives access to signal conditioning options, built-in the hardware unit.

- **Active channels**

Among the possible channel(s) available on the acquisition unit, define which channels will be active for both acquisition and calibration.

- **Transducer**

The transducer configuration loads the transfer function of the selected transducer and allows the conversion of measured data into an input voltage and the reverse process after data analysis to display the results. A transducer must be prescribed to each active channel.

- **Calibrator**

The calibrator configuration allows the user to perform the calibration routine, which adjusts the transfer function of the transducer in order to perform calibrated measurements. A calibrator must be declared for each active channel (except for measurement channels with a voltage-type transducer).

💣 **To enable direct power supply of a transducer from a HARMONIE or SYMPHONIE unit, define the same option(s) for the transducer(s) and for the hardware platform (Configuration command) in the dBCONFIG tool.**

📖 *For more information concerning hardware configuration, refer to the getting started manual delivered with your measurement system.*

- **Remote control tab**

The dialogue box shown below allows the user to configure the parameters of the dialogue between a remote control object and the measurement software to perform a specific operation (ex: threshold trigger of an visual alarm, remote control by push button for audio triggering, remote control for the measurement control from the holder of an intensity probe).
Several remote controls are available. For more information concerning its configuration and use, refer to the chapter Remote controls.

- **Phase correction tab**

Select this option, in order to activate the phase correction during intensity measurements. After selecting this option, it is necessary to load the phase correction file (.AU) corresponding to the used probe, using the selection button >>.

The tab of the dialogue box shown above indicates the file of the selected phase correction.
The calibration files of the probe (*.AU) may be defined in the program dBSONDE.
The user may whether input the residual space manually (with the calibration chart of the manufacturer) or measure it.

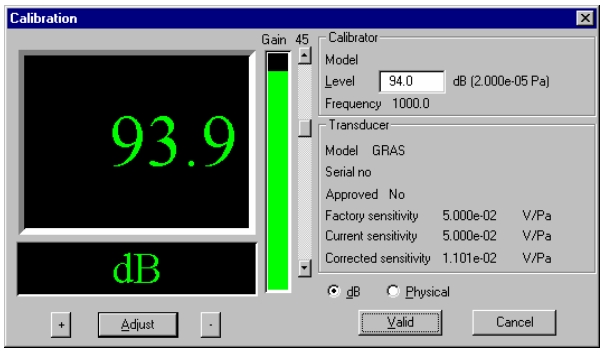
7. MEASUREMENT CHAIN CALIBRATION

This chapter concerns only intensity and Sound power (ISO9614) modes.

Calibration is recommended before every measurement. Calibration guarantees the reliability of the results.

Calibration affects the sensitivity of the selected transducer by adjusting it as a function of measured and expected values (defined by the frequency and level characteristics of the calibrator). The calibrators and transducers are defined by using dBCONFIG and they are selected using the **Hardware configuration** command in the **Acquisition** menu.

The current calibration is done using Leq over a 125-millisecond period. It measures the Leq value of the input signal and converts it into the unit set in the transducer's characteristics. By adjusting the level to the expected level, it changes the sensitivity of the transducer. By validating it, the adjusted value will now become the default value for the next time the program is used.



Access **Calibration** via the **Set-up** menu.

The input gain and transducer sensitivity may be calibrated from the control panel Values may be modified using the "+", "-" and "Adjust" buttons.
Calibration levels can be expressed either in **dB** or in **physical** units.

On validation, the system is ready to carry out calibrated measurements.

Before calibration:

- Verify that the calibration signal remains constant for a sufficiently long period.
- Verify that the gain view meter is correctly positioned (no underload, no overload).
- It is preferable to place the calibrator on foam to reduce the effect of vibrations.

After calibration:

- If, for the same transducer / calibrator pair, the sensitivity after calibration differs greatly from the original sensitivity, damage to the microphone may have occurred.

- If the measured values are not correct but the calibration value is OK, it could mean that the sensitivity of the microphone is correct only at 1 000 Hz. Check the microphone membrane.

A microphone is very fragile equipment. A fall of 10 cm may damage the microphone membrane. As general rule, if the measured value in dB varies by +/- 1.5 dB from the value that would be measured with the microphone according to the original sensitivity (see calibration data sheet), consider your microphone as faulty.

***Example*: For a microphone that as a factory sensitivity of 50 mV / Pa and a calibrator that delivers 94 dB at 1000 Hz.**

The microphone is able to perform correct measurements if:

- **The measured calibration level lies between 92.5 dB and 95.5 dB.**
- **The current microphone sensitivity lies between (around) 40 mV/Pa and 60 mV/Pa (multiply or divide the original value by a factor of 1.1885)**

For greater or lower microphone sensitivities, consider the microphone as faulty. Return it to your 01dB-Metravib agent

8. INTENSITY MODE

dBFA can be used to perform real-time acquisition of autospectra and cross-spectra in narrow bands (first and second FFT passes) as well as sound intensity and averaged sound pressure cross-spectra in octave or third octave bands by FFT analysis.

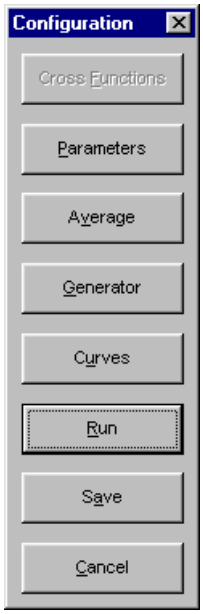
The characteristics of a sound intensity probe (microphone spacing, etc.) can be defined by the user to perform sound intensity measurements (acquisition of the active sound intensity level Li, the reactive sound intensity level Lj and the free filed sound intensity level SIL).

All the measured quantities can be displayed in narrow bands (for each FFT pass) or in octaves and third octave bands (recomposition from the FFT analyses).

The cross-spectra in narrow bands can be displayed either in polar form (modulus and phase) or complex form (real and imaginary parts).

An internal signal generator can be used as an option to generate a white noise, a pink noise, a sinus or a loop signal through an amplified loudspeaker. Signal recording can also be performed in the real-time acquisition mode.

Use the command **Acquisition / New measurement set-up** to start a new measurement. The dialogue box shown opposite appears on screen.



The dialogue box shown opposite appears on-screen after creation a new real time measurement mode. The user can define the main acquisition parameters before starting the measurement itself

Following steps may be done:

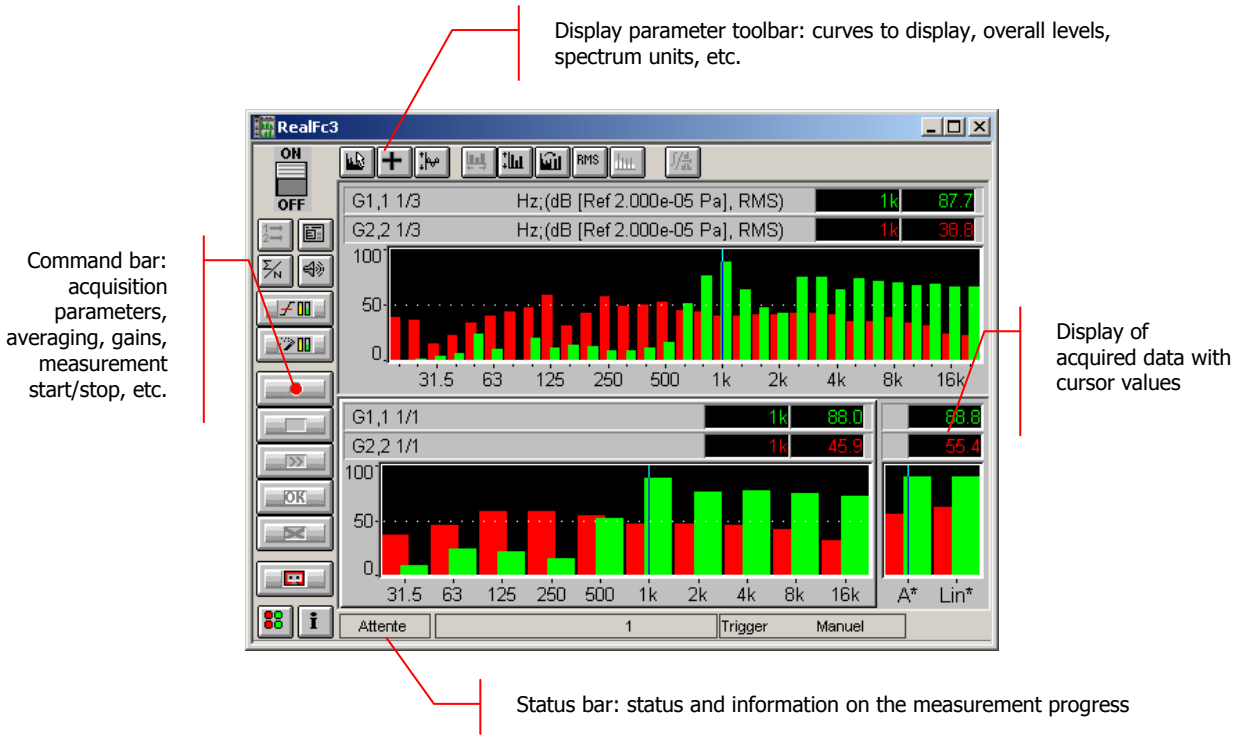
- Activate calculation of **cross functions** between active channels (if possible).
- Define the acquisition **parameters**: frequency range, resolution, quantities to store, etc.
- Define the **averaging** parameters: type of averaging, averaging duration.
- Activate or disable the internal noise **generator** (white, pink, sinus, loop) (option).
- Define the **curves** to be displayed in the measurement window.
- **Run** the measurement. The real time measurement window appears on-screen.
- **Save** the measurement configuration. All the parameters of the measurements are saved in a configuration file with the extension *.INT for this real-time acquisition mode.

The user may use this configuration again for other measurement sessions with the same parameters (command **Acquisition / Open a measurement set-up**).

The real time measurement window appears after setting up all parameters. Each function is now accessible from the measurement window toolbars.

8.1. Measurement window overview

An example of a real time intensity mode measurement window is given below:


Display parameter toolbar: curves to display, overall levels, spectrum units, etc.
Command bar: acquisition parameters, averaging, gains, measurement start/stop, etc.
Display of acquired data with cursor values
Status bar: status and information on the measurement progress
RealFc3
ON
OFF
G1,1 1/3 Hz;(dB [Ref 2.000e-05 Pa], RMS) 1k 87.7
G2,2 1/3 Hz;(dB [Ref 2.000e-05 Pa], RMS) 1k 38.8
100
50
0
31.5 63 125 250 500 1k 2k 4k 8k 16k
G1,1 1/1 1k 88.0 68.8
G2,2 1/1 1k 45.9 55.4
OK
A* Lin*
Attente 1 Trigger Manuel

The measurement configuration and control is accessible via the vertical **command toolbar**. In the following, we describe the functions of each icon:

	Enable/disable cross function computation		Stop the acquisition
	Define acquisition parameters		Continue the acquisition
	Define averaging mode and attributes		Validate current results
	Internal signal generator (option)		Cancel current results and start again
	Define gain an threshold parameters		Start audio record (option)
	Perform an automatic gain adjustment (autorange)		Show/hide overload bar
	Start acquisition		Show/hide information table

The display type and the display parameters of the active curves are controlled using the **horizontal toolbar**:

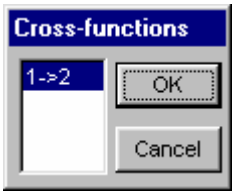
	Select curves to display		Select overall levels to display
	Select curve layout type		Select spectral units display
	Perform a Y-axis autoscale for all curves		Harmonic cursor parameters
	Define Y-axis parameters		Integration / Differentiation of displayed spectra

8.2. Measurement set-up

All the functions described below are accessible from the command toolbar of the measurement window

8.2.1. Cross-functions

Use the command **Config / Cross function** to define the acquisition of cross spectra and transfer functions between active measurement channels. The following dialogue box appears.



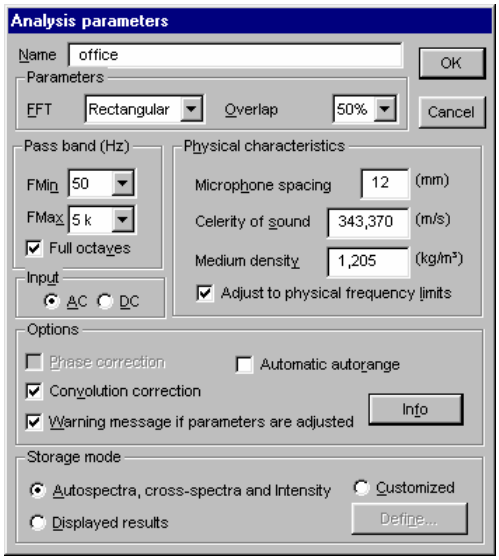
This dialogue box allows the user to activate (or not) the calculation of cross functions during acquisition and gives access to the transfer functions (coherence) as well as the computation of sound intensity and mean pressure level spectra.

The option **1->2** activates the cross function calculation from channel 1 to channel 2.

When cross-function computation is not active, only autospectra in narrow bands (first and second FFT passes) and in octave and third octave bands can be measured.

8.2.2. Acquisition parameters

Use the command **Config / Parameters** to define general acquisition parameters. The dialog box shown below appears on-screen. The following parameters may be defined :



- **Name**

Input a measurement identifier. This identifier appears in the field "Location" of the measurement session.

- **FFT Window**

Choose the FFT window for the analysis. The following windows are available: Rectangular, Hanning, Hamming, Kaiser-Bessel, and Flat Top.

- **Overlap**

Choose the overlap factor for the analysis amongst the following quantities: 0, 25%, 50% and 75%.

These factors depend on the hardware platform possibilities and the chosen bandwidth.

- **Pass band (Hz)**

Define the upper and lower limits of the analysis pass band. These values are the third octave frequency bands. The pass band depends on the microphone spacing, of the selected minimum frequency and the activation or deactivation of the convolution correction.

If the option **Full octaves** is activated, the pass band is reduced to contain only the "full" octaves: The minimum frequency is replaced by the minimum value of the upper octave band. The maximum frequency is replaces by the maximum value of the lower octave band.

- **Input**

The programme allows the user to choose between **AC** or **DC** input. With this option the continuous component of the signal can pass or not. By using the AC input a 0.5 Hz high pass filter is included in the signal chain.

When the option AC is chosen, it is necessary to use specific cables.

- **Physical quantities**

The microphone spacing is only needed for the calculation of sound intensity level (Li, Lp, Lj, SIL) with a sound intensity probe. It has an influence to the measurable frequency range according to the table below.

The table below summarises these interactions for various microphone spacing. The value between brackets gives the high frequency limit when the convolution correction is activated.

Fmin (Hz) / Spacing (mm)	→ 20	25 to 40	50 to 80	100 and +
50	**12,5 – 1K (1,25K)**	**25 – 1K (1,6K)**	**50 – 1K (1,6K)**	**100 – 1K (1,6K)**
25	**25 – 1,25K (1,25K)**	**25 – 2K (2,5K)**	**50 – 2K (3,15K)**	**100 – 2K (3,15K)**
12	**50 – 2K (2K)**	**50 – 4K (4K)**	**50 – 4K (5K)**	**100 – 4K (6,3K)**
6	**100 – 2K (2K)**	**100 – 4K (4K)**	**100 – 8K (8K)**	**100 – 8K (12,5K)**

The physical limitation of the frequency range is due, for high frequencies to the approximation of the pressure gradient and, for low frequencies to the microphone spacing (the lager the spacer, the lower the frequency band accessible).

With a 12 mm spacer (and the convolution correction activated), the software the frequency range required by the international standard (50 Hz - 6,3 kHz) but the user can advantageously perform its sound intensity measurements in two stages:

- A first series of measurements with a 12mm spacer for high frequency bands,
- Then a second series with a 25-mm spacer to cover low frequency bands.

The field **Celerity of sound** allows to define the sound velocity in the measurement conditions. This value has an influence on the intensity measurement.

The field **Medium density** allows to define the medium density in the measurement conditions. This value has an influence on the intensity measurement.

The option "**adjust to physical frequency limits**" automatically reduces the pass band to a limit pass band, in which the intensity may be calculated correctly.
After activation this option adjust the limits of the frequency ranges Fmin and Fmax so as they are included in the physical frequency limits.

With the button **Info,** the user may display the setting criteria of its physical frequency limits and the microphone space values as well as the residual pressure-index of the probe.

- **Options**

The option **phase correction** allows the user to activate the phase correction during an intensity calculation. With the phase correction the user may correct the measured values in relation to the intrinsic phase shift of the probe (that is included in the phase correction file, defined in the hardware configuration).

The option **Convolution correction** allows the user to activate the convolution correction during an intensity calculation. With the convolution correction, the user may correct (within a limit of 3 dB) the high frequency error due to the approximation of the pressure gradient

When the option **Warning message if parameters are adjusted** is validated, a dialogue box appears, during validation of the current dialogue box, to display the adjusted parameters if needed.
When this option is inactive, the programme adjusts automatically the parameter values in relation to the possibilities of the acquisition unit.

The option **Autorange** starts automatic gain setting at the start of each measurement.

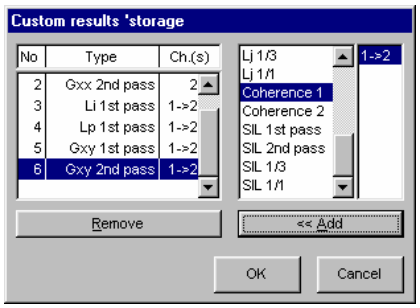
- **Storage modes**

Choose **Autospectra, cross spectra and intensity** in order to save (after starting the measurement), the auto spectra and if necessary the cross spectra as well as the intensity spectra (active and reactive intensity) and the mean pressure level spectra.

The octave band, third octave band and narrow band (first and second pass FFT) spectra for each quantity are stored in the measurement session datafile.

Choose **Displayed quantities** in order to save (after starting the measurement) only the spectra that are displayed in the real time measurement window.

Choose **Customise,** in order to carry out a personalised storage. The programme stores the curves accessible for the current operating mode. To define the quantities to be stored, click on the button **Define**, the dialogue box custom results' storage appears.



The list on the right indicates the different spectra types and its channel references that may be stored.

The list on the left indicates the different spectra types that will be stored after validation of the measurement results.

The cross spectra, intensity spectra and the mean pressure level spectra are only accessible if the cross function computation is activated.

Reminder
Gxx: Autospectra
Gxy: Cross spectra

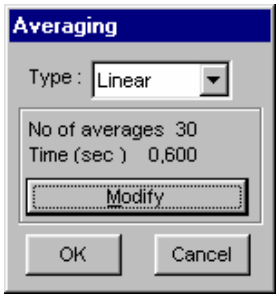
Li: Active intensity
Lj: Reactive intensity
SIL: Free field intensity
LP: Mean pressure levels

1st pass: first FFT pass (narrow bands)
2nd pass: second FFT pass (narrow bands)

1/1: octave bands
1/3: third octave bands

To activate data storage of a given spectrum, select its type and the reference channels. Then use the command **Add**, in order to add the spectra to the storage list (left hand side). The user can also carry out this action by double clicking on its representation in the right hand side list.

8.2.3. Averaging parameters



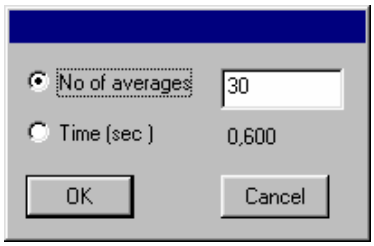
Use the command **Config / Average** to define the averaging parameters of the measurement. The dialogue box shown opposite appears on screen.

This dialogue box allows the user to modify the type of averaging and the number of averages or the measurement duration.

There are 2 main types of averaging:

- **Linear**: This averaging mode gives the same weighting to all samples, which means a linear average on N samples that stops as far as the N^{th} sample is reached.
- **Exponential**: This averaging mode gives the highest weighting to the last reached sample and reduce progressively the influence of the previous samples. An exponential average does not stop.

In this dialogue box, the user can **modify** the number of averages to take into account and the averaging duration. These two parameters are linked by the general acquisition parameters (number of lines, pass band).



8.2.4. Internal signal generator (option)

Use the command **Config / Generator** in order to define and activate the internal signal generator. The following dialogue box appears on screen.

Using **dBFA** with the **SYMPHONIE** or **HARMONIE** hardware platforms, a **white noise**, **pink noise**, a **sinus** signal (whose **frequency** we define) can be generated.

Choose the option **Loop** to loop the input signal on the output of the hardware platform.

The generator is active when the box **On/Off** is activated.

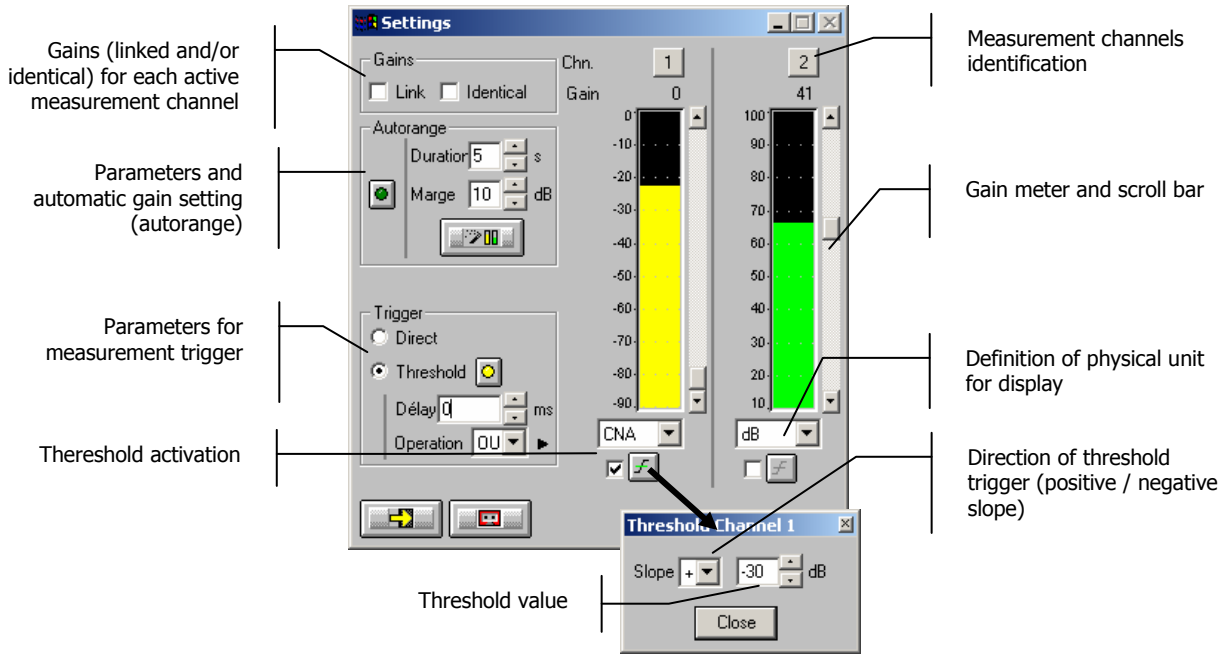
Then connect an amplified loudspeaker to the output of the acquisition unit.

With **SYMPHONIE**, the signal output level can be set by clicking on the icon, in Windows taskbar. Select the acquisition platform and click on Properties to set the output level of **SYMPHONIE** (**Attenuation setting (dB)** field).

For more information on the acquisition system (for instance, output wiring, setting of output volume), please refer to the system installation manual.

8.2.5. Threshold, gain and autorange settings

This dialog box enables the definition of gain and threshold settings. These parameters can be used in several ways by the application software. All parameters and the available actions may be enabled or disabled according to the acquisition module, which calls this command.



❑ **Gains**

When the option **Linked** is active, the gains on all active measurement channels are modified: the gain setting of one active channel leads to identical modifications on all active measurement channels.

The gains on the active channels are identical, if the option **Identical** is activated. Each setting of one channel is passed to all other active channels. This option is only available if the option **linked** has been chosen.

❑ **Autorange** . Start automatic gain setting according to the input level on the hardware platform.

The autorange proceeds as follows: during the **duration,** defined in the dialogue box, the programme stores the highest reached value and adjust the gain so that this value is located "x" dB (**margin** defined in the dialogue box) below that maximum measured value.

❑ **Units: Definition of the display unit of the input level.** The gain view meters may display the input levels according to three different units:

- **dB**: Display the view meters in physical decibel. This is a relative level in dB calculated according to the transducer sensitivity and the reference 0 dB of the transducer type.
- **ADC**: Display the view meters in converter decibel. This is a relative level in dB. The level 0 dB is defined as the full scale of the converter. The values in dB ADC are always negative between 0 and -90 dB.
- **Unit**: Display of the view meters in physical units. In case the transducer is a pressure microphone, the view meter displays the values in Pascals (Pa). In case the transducer is an accelerometer, the view meter displays the values in m/s².

📖 *The levels are calculated from international system units (SI). It is possible to modify the default values with the command **Preferences / Units' management** (see **Section 19.1**).*

- **Trigger:** Define here the trigger parameters used for acquisition.

  - **Trigger selection: Direct:** to start the measurement immediately after clicking on the start acquisition command or **Threshold:** to start the acquisition with a threshold condition (negative or positive) defined on the right hand side. The programme waits for the threshold, when the measurement start command is activated.

  - **Trigger delay (in ms)**: For threshold triggering, it is possible to start the acquisition with a pre-delay or a post-delay in relation to threshold crossing. Input this delay or use the arrows up/down to increase/reduce the value

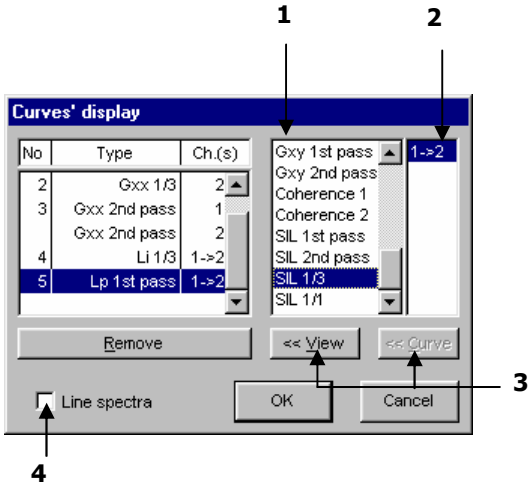
  - **Operation**: Select a logical Boolean operator for the threshold trigger: **OR** to activate the recording if one of the conditions is fulfilled and **AND** to activate the recording when all conditions are fulfilled.

8.3. Display configuration

All these functions are accessible from the horizontal toolbar of the measurement window.

8.3.1. Curves to display

Use the command **Display / Curves** to define the data to display in the measurement window. The following dialogue box appears on screen.



Gxx : Autospectra
Gxy : Cross spectra

Li : Active intensity
Lj : Reactive intensity
SIL : Free field intensity
Lp : Mean pressure

1st pass : first FFT pass (narrow bands)
2nd pass : second FFT pass (narrow bands)

1/1 : octave bands
1/3 : third octave bands

❶ Choose the quantities to be displayed in the list of available quantities. For the real time intensity mode, the user may display the following data:

Cross function deactivated	Cross function activated
Autospectra for each measurement channel Gxx pass 1, Gxx pass 2, Gxx 1/3, Gxx 1/1	Li pass 1, Li pass 2, Li 1/3, Li 1/1 Lj pass 1, Lj pass 2, Lj 1/3, Lj 1/1 Cross spectra Gxy pass 1, Gxy pass 2, coherence 1, coherence 2 SIL pass 1, SIL pass 2, SIL 1/3, SIL 1/1 Lp pass 1, Lp pass 2, Lp 1/3, Lp 1/1

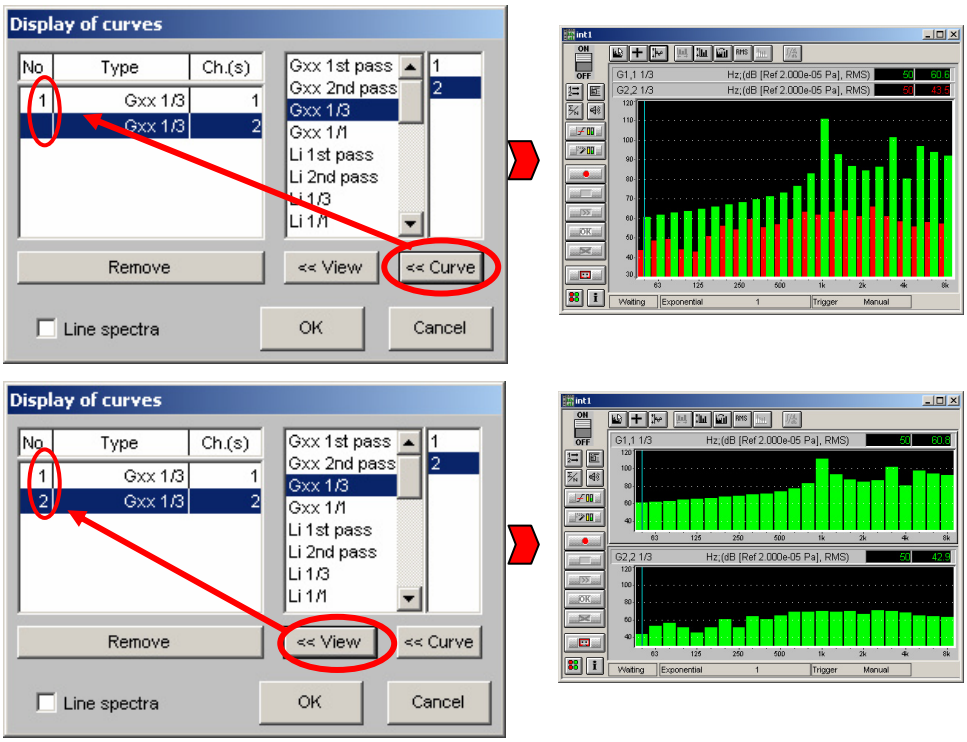
❷ The right column of the dialogue box allows to combine the previous chosen quantities with the selected measurement channel(s).

Example: If working with two channels, this column allows to choose the autospectrum display of the wanted channels.

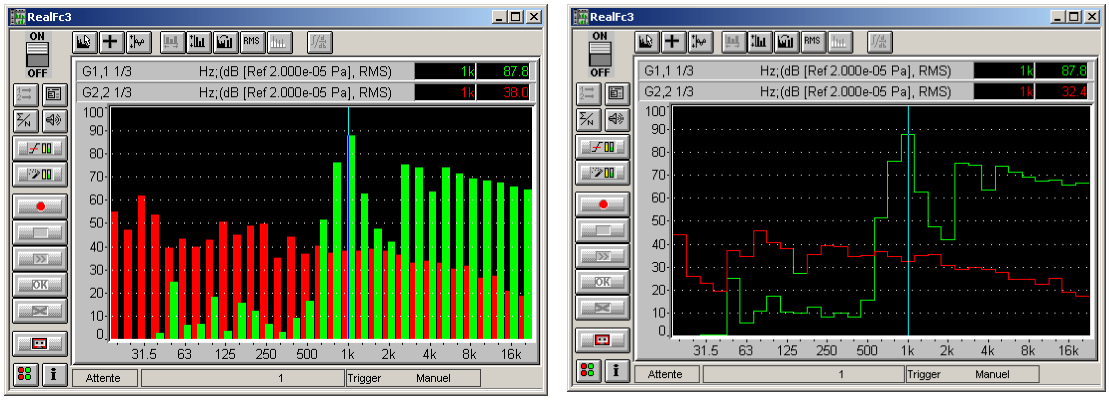
❸ The curves, which will appear on the display are the curves displayed in the left column of the dialogue box.

Use the button **View,** in order to add a new spectrum line to the list. To superimpose a spectrum in an existing line, use the button **Curve.**

The programme enables the user to display as much lines as wanted in the real time measurement window and offers the possibility to superimpose several curves on the same view (when the curve types are compatible). An example is given below:



❹ If **Line spectra** is marked, the bar spectrum is replaced by a line spectrum. An example of a spectrum with the same signal in the two modes is given below:



Bar-type spectra Line-type spectra

8.3.2. Display dynamic configuration

Use the command **Display / Y-axis** to select the display dynamic manually. The following dialogue box appears on screen.

This dialogue box allows the user to modify the unit of the Y-axis as well as the **minimum** and **maximum** values of the used scale.

There are two possible display units:

- **dB**: the dynamic is displayed in decibels according to the IS reference and depends on the transducer type of each channel.
- **Lin**: the dynamic is displayed in physical units according to the transducer type.

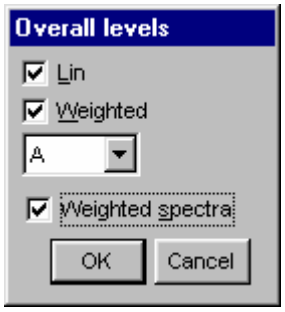
The defined parameters are only applied to the active curve after validation of the dialogue box.

The command **Actions / Autoscale (F9)** allows the user to adjust the display dynamic of all existing curves according to the measured levels.

'Autoscale' adjusts automatically the scales of the Y-axis of all curves, in order to enable a correct visualisation of all curves.

8.3.3. Overall levels

Use the command **Display / Overall levels** to display up to two overall levels on the right hand side of the active display in the measurement window. The following dialogue box appears on screen



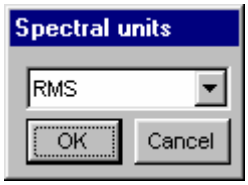
The display of overall levels is only possible for autospectra and authorises the display of:

- The overall Lin level (unweighted),
- An additional weighted overall level (A, B, C, etc.)

The option **weighted spectra** activates spectrum display using the selected frequency weighting. The spectra will be weighted in this case.

*Refer to **paragraph 11.3** for a complete list of frequency weightings available in **dBFA**.*

8.3.4. Spectral units



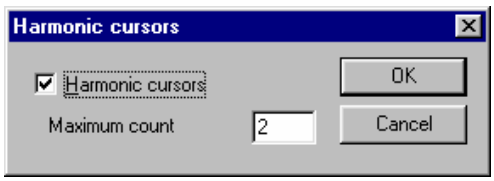
Use the command **Display / Spectral unit** to modify the spectral unit of the spectrum of the active window. The dialogue box shown opposite appears on screen.

You can choose amongst the following spectral units: **ASD, PSD, RMS, and PWR.**

*Refer to **paragraph 11.4** for a complete list of spectral units available in **dBFA**.*

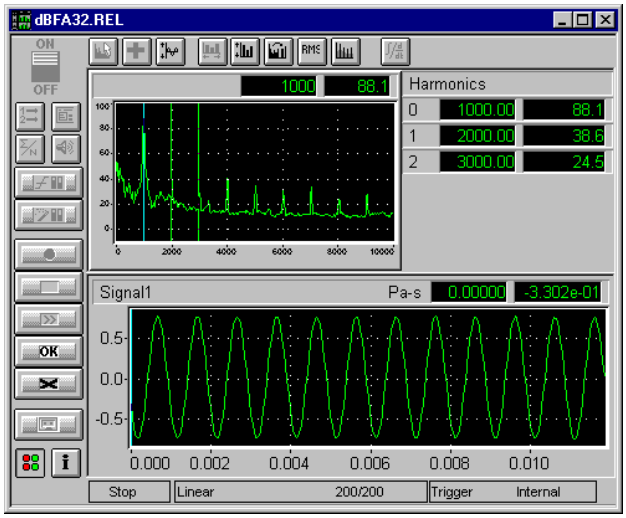
8.3.5. Harmonic cursors

Use the command **Display / Cursors** to display the harmonic cursors on the graphical view of a narrow band spectra. The following dialogue box appears on screen.



Define the **maximum count** of harmonic cursors that you would like to see on the graph.

The main measurement window then looks as follows:



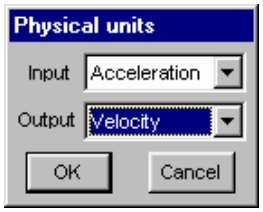
The display of the levels corresponding to the different markers appears on the right hand side of the spectrum.

8.3.6. Integration / Derivation of spectra to be displayed

Use the command **Display / Integration / Derivation** to carry out a simple or double integration / derivation of an active narrow band spectrum in the main window of the real time mode. The following dialogue box appears on the screen. There are two cases:

- **Derivation / Integration of an autospectrum.**

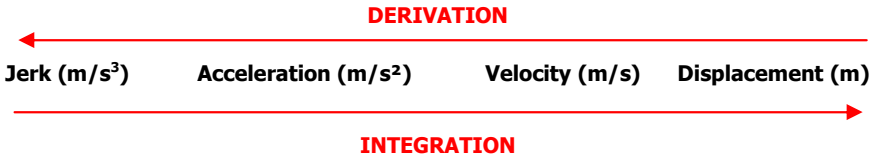
According to the physical unit of the measured spectra, the spectra is displayed, integrated or derived.



- **Derivation / Integration of a transfer function.**

The user may visualise the chosen transfer function by integration / derivation of the input and/or output spectrum, according to the physical unit of the input and output function (an autospectrum or a cross spectrum for each case).

The possible selections for each type are summarised below:



8.4. Measurement process

After measurement configuration the user can control the measurement process with the following icons:

Start an acquisition (F3)
The acquisition starts according to the defined acquisition and averaging parameters. When a trigger condition is defined (with the command Gain and threshold), the analyser waits for the trigger event, in order to start the measurement.

Stop an acquisition (F4)

Continue a stopped measurement (F5)
This function continues averaging the previous results with measured values.

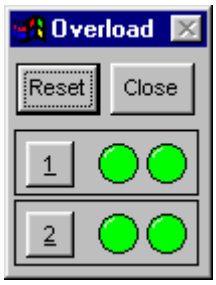
Valid current results (F7)
The measurement results are saved in a measurement session datafile.

Do not accept current results and restart the measurement (F6)

Start a signal recording (F12)
Start a signal recording directly from the real time measurement window. The audio record will be carried out according to the user-defined duration, the other parameters (gains, frequency range, etc.) are identical to the current real time analysis parameters.

Spectrum measurement is deactivated during signal recording. A recording progress indicator appears in the status bar of the real time window giving a percentage of the total recording progress.

Show/hide the overload bar.
The overload dialogue box appears on screen when this command is activated. This dialogue box enables detection an overload at any time.



There are two indicators for each channel, one for the instantaneous overload, another one for memorisation of the overload. The button **Reset** allows to reset the indicators.

The instantaneous overload indicator becomes red as soon as an overload occurs on a given channel and becomes green again when it is terminated.

The indicator, which memorises the overload, becomes red as soon as an overload occurs and stays red until the button **Reset** is pressed.

9. ORDER EXTRACTION

Order analysis is based on the frequency analysis of a system's sound or vibration emission, which is related to its rotation speed and the harmonics of the rotating parts (orders).

This measurement method mainly applies to **rotating machinery** with fixed or variable speed. One can thus observe effects generated by rotating elements and their amplifications due to structural resonances.

During an order analysis, one or several sound or vibration measurement channel and one tachometric signal are recorded simultaneously.

With **dBFA**, order extraction can be carried out from a **FFT frequency analysis**:

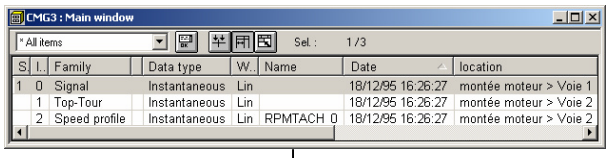
- Either in **real time** (please to the chapter concerning Analyser mode in dBRTA user manual),
- Or in **post-processing** mode (*.**BOE** files), on existing recordings (in this case, the tachometric signal can be acquired on a dynamic channel to be analysed more precisely).

In this chapter, only the post-processing mode is described.

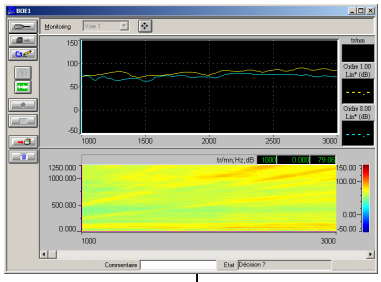
Caution! *Do not mix up* ***order extraction*** *and* ***order tracking****.*
During an order analysis with ***order tracking****, the signal is sampled according to the system rotation speed, whereas an order analysis with* ***order extraction*** *is carried out from a FFT frequency analysis.*

POST PROCESSING

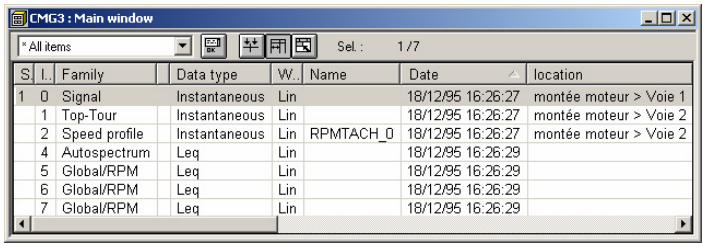
Open a session
and select signal recordings


CMG3 : Main window
* All items
Sel. : 1 / 3
S. I.. Family Data type W.. Name Date location
1 0 Signal Instantaneous Lin 18/12/95 16:26:27 montée moteur > Voie 1
1 Top-Tour Instantaneous Lin 18/12/95 16:26:27 montée moteur > Voie 2
2 Speed profile Instantaneous Lin RPMTACH_0 18/12/95 16:26:27 montée moteur > Voie 2

Process recordings
(windowing, averaging…)



Add autospectra, cross spectra, transfer
functions… to the measurement session.

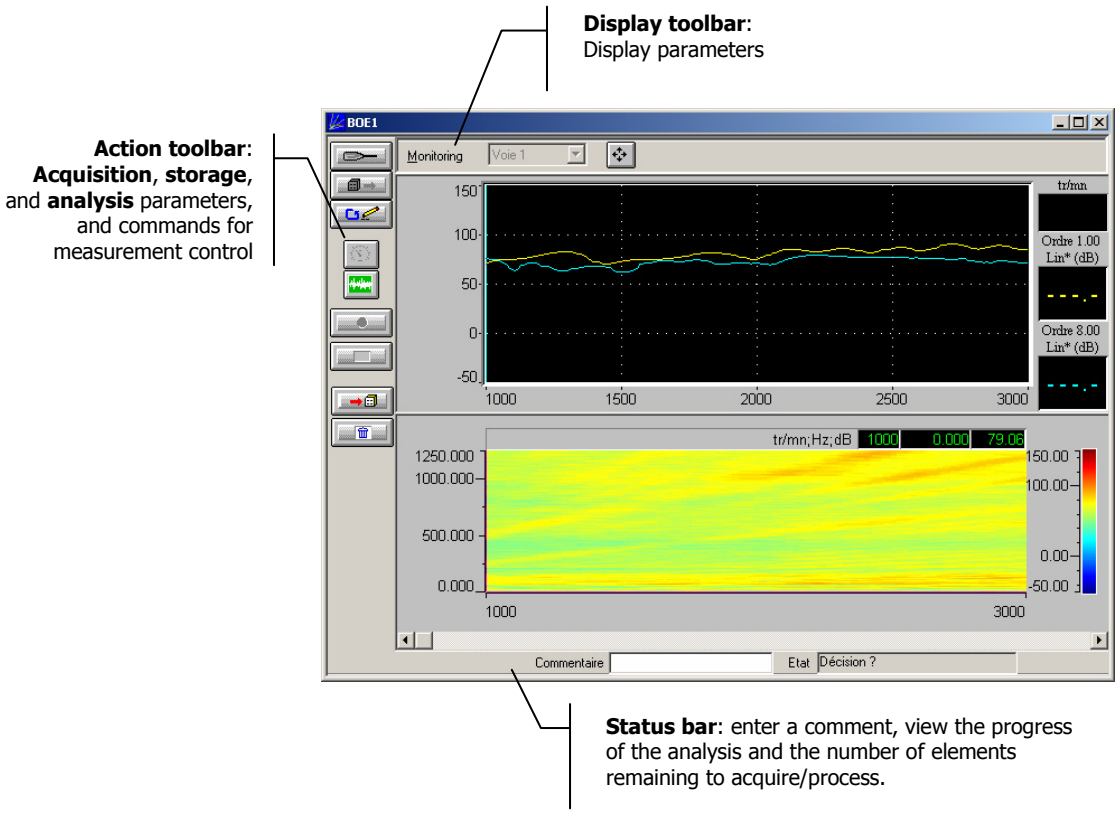

CMG3 : Main window
* All items
Sel. : 1 / 7
S. I.. Family Data type W.. Name Date location
1 0 Signal Instantaneous Lin 18/12/95 16:26:27 montée moteur > Voie 1
1 Top-Tour Instantaneous Lin 18/12/95 16:26:27 montée moteur > Voie 2
2 Speed profile Instantaneous Lin RPMTACH_0 18/12/95 16:26:27 montée moteur > Voie 2
4 Autospectrum Leq Lin 18/12/95 16:26:29
5 Global/RPM Leq Lin 18/12/95 16:26:29
6 Global/RPM Leq Lin 18/12/95 16:26:29
7 Global/RPM Leq Lin 18/12/95 16:26:29

9.1. Post-processing analysis

To create a new post-processing order extraction configuration, use the **Analysis / New analysis set-up** command. To save display and measurement parameters in a ***.BOE** file, use **File / Save as**. It is thus possible to load an analysis with the exact same configuration as that of the recording (**Analysis / Open analysis set-up**).

9.1.1. Description of the analysis window

In the post-processing order extraction module, it is possible to display in the same window the overall level and the order history, as well as a sonagram calculates according to the analysis parameters defined by the operator.



The following operations are available from the **Display toolbar** in the order extraction window:

Manual setting of the display dynamics

Selection of the channel to display

The following operations are available from the **Action toolbar** in the order extraction window:

Set processing parameters.

Transfer selected elements from session to batch (elements to process).

View / Edit current batch (elements to process).

View speed (tachometric channel).

View signal (oscilloscope)

Launch processing.

Stop processing.

Transfer results to measurement session.

Discard current results.

Refer to Section 9.2.4 for a detailed description of the analysis process.

9.1.2. Analysis set-up

All these functions are available from the (vertical) action toolbar in the measurement window.

9.1.2.1. Batch window (elements to process)

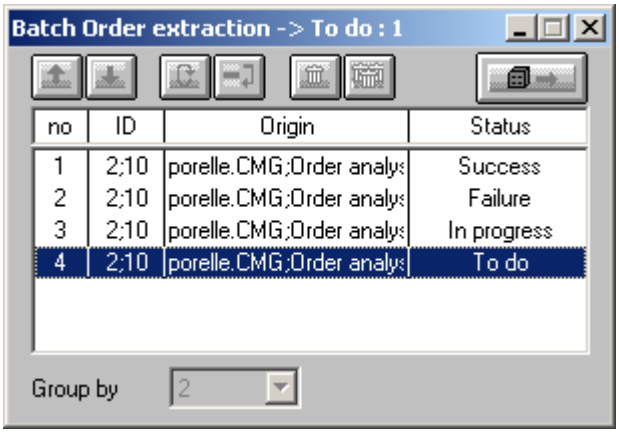
Use **Actions / Edit** (F8) to manage the list of Signal and Speed profile items to process in the order extraction module of **dBFA**. To be valid all items should be inserted in the batch in the following order:

- If grouping by two, put one Signal item, and then a Speed profile item
- If grouping by three, put two Signal items and then one Speed profile item
- … Always put Signal items before Speed profile items.

To save time, select items in the active session, one by one, in the right order, by holding the "CTRL" key down, and insert all elements in the batch at the same time.

The number of items remaining to be processed is displayed in the title bar.

Use this icon to import Signal and Speed profile items in the order extraction module without using the batch window.



The **status** of the processing is shown for each element, as well as its **origin** (target session) and its **identification** number (ID) in the session.

Transfer selected items from the session to the batch.

Sort signal recordings for analysis.

Reset the batch.

For all items in the batch, the status changes to "To process". This function can be used to restart an analysis using a different windowing on a set of existing recordings.

Deactivate the processing for the selected items (status = "**Inactive**").

Delete selected items from the batch.

Delete all items from the batch.

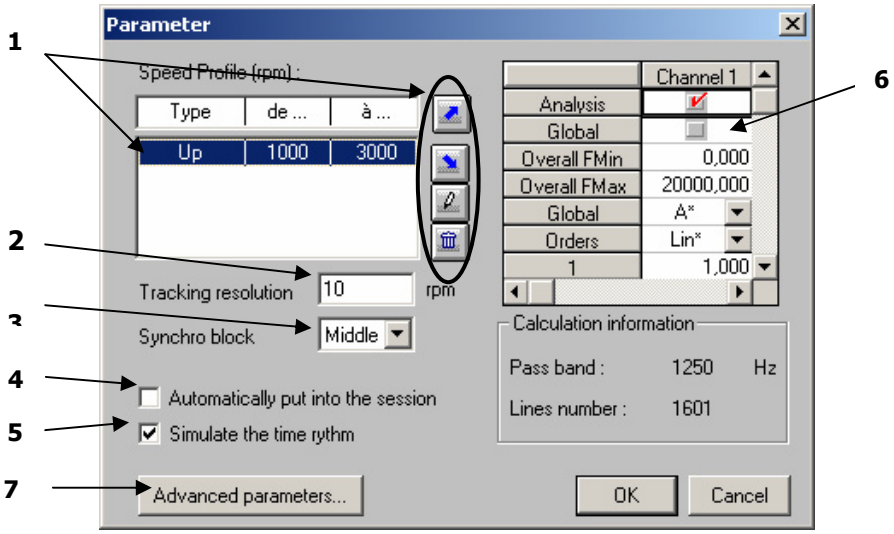
"Group by" ***(1 to 4)***: Process elements one after the other or by groups of two to four (multi-channel recordings).

If there is an odd number of elements to process, and if they are grouped by two, the last element in the batch becomes inactive (it will not be processed).

9.1.2.2. Analysis set-up

Use or **Actions / Parameters** (F5) to define the measurement and analysis parameters for the order extraction.

Parameters of the elements to analyse are set in the dialog box shown below:



❶ Definition of the parameters for the sequence of run-ups and/or coast-downs on a speed range to define **(Speed profile**)

add a run-up

add a coast-down

modify the run-up or coast-down value for the selected item

delete selected item

❷ Use the **Tracking Resolution** to define the speed interval between two FFT spectrum calculations.

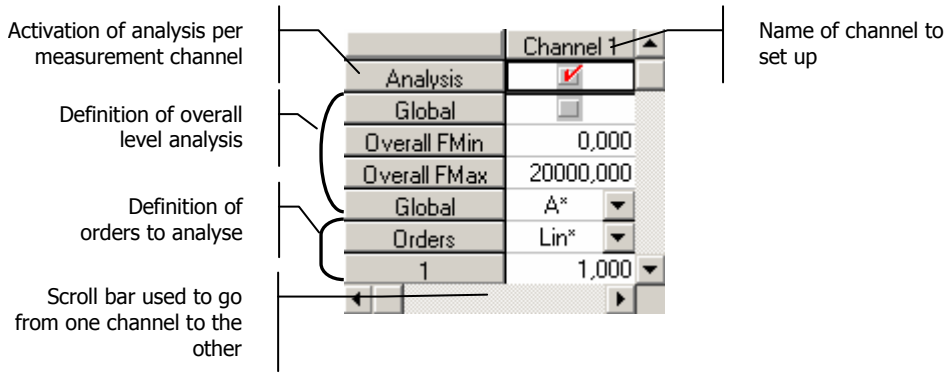
❸ The **Block synchro** parameter is used to assign a FFT spectrum to a speed.

- Either the spectrum is assigned to the speed measured when the data storage (for spectrum calculation) started (**Start**),
- Or the spectrum is assigned to the speed measured when the said data storage ended (**End**),
- Or the spectrum is assigned to the average speed between the beginning and the end of data storage (**Middle**)

❹ When the box **"Automatic transfer to session"** is checked, results are automatically transferred to the measurement session, and this to save time when running a series of analyses.

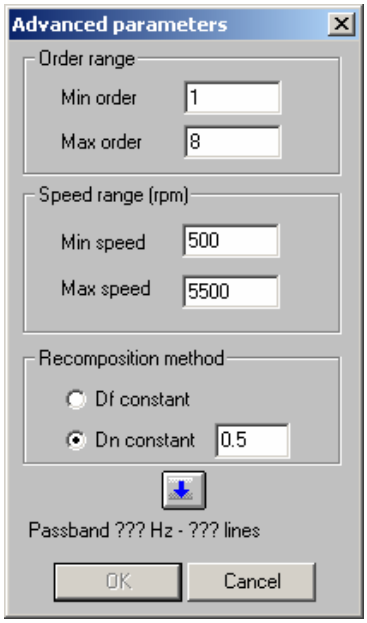
❺ When the **"Simulate timing"** box is checked, the analysis time is the same as for a real-time measurement. If the box is not checked, the analyses takes up all the PC resources and can then go faster.

❻ Definition of data to store in the measurement session. There is one column per channel.



- **Analysis**: Activation of analysis per measurement channel
- **Overall Fmin and overall Fmax**: Frequency limits for overall level calculation
- **Overall**: Activation of overall level analysis
- **Overall weight.**: Weighting applied to the overall level (if **Overall** is active)
- **Order weight.**: Weighting applied to the order calculation
- **1, 2, ..., 8**: Enter here the number of the order to extract from the analysis. Orders can be non-integer. 8 orders maximum can be extracted.

❼ **Advanced parameters** are used to define measurement parameters (maximum frequency and number of lines) according to the study to carry out.



- **Order range**: Enter the limits for the study (minimum and maximum orders to extract).
- **Speed range**: Definition of the speed range for the whole study. It should include the speed profile (sequence of run-ups and/or coast-downs) defined previously (❶).
- **Recomposition method**: Define which frequency band will be used for the energy calculation of orders.

With **Df constant**, the frequency band used to calculate the order will be a band of constant width Df.
With **Dn constant**, the frequency band used to calculate the order energy will be a frequency band proportional to the speed, and increasing with the frequency (Df=Dn*Speed/60, with the speed in rpm).

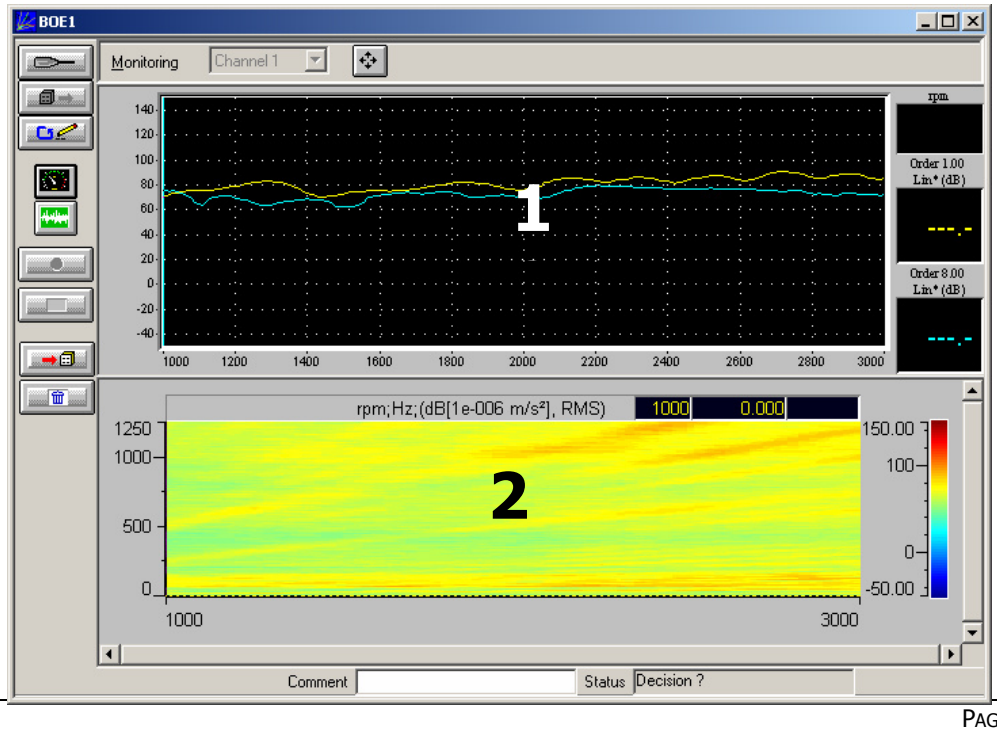
When all parameters have been entered, click on to launch the calculation of the bandwidth and of the required number of lines for the measurement, then validate.

$Speed_{Max}$ (rpm) and $Order_{Max}$ are used to calculate the bandwidth (BP).
*The number of lines N is calculated from the bandwidth and the most restricting Df (the smallest) according to the selected recomposition method, keeping in mind that at least 5 FFT lines are required by **dBFA** in the extraction bandwidth.*

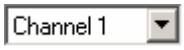
$$BP = \frac{Speed_{Max}}{60} \times Order_{Max} \qquad N = \frac{BP}{\left(Df/5\right)}$$

9.1.3. Display set-up

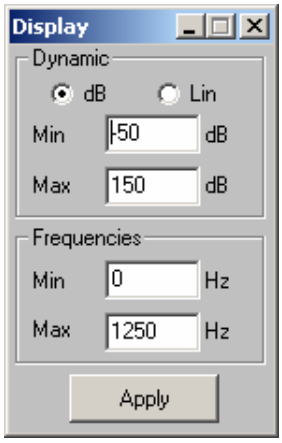
With the post-processing order extraction module in **dBFA**, the history of overall levels, orders ❶ and a sonogram calculated according to analysis parameters selected by operator ❷ can be displayed in the same window.



9.1.3.1. Display set-up

Use 

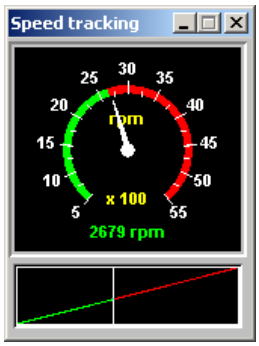
to select the channel to display.



Use or **Plot / Parameters** to define the display dynamic range.

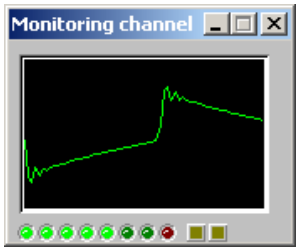
- **Dynamic**: set view ❶
- **Frequency**: set view ❷

It is also possible to display a meter showing the real-time speed using the button,



Speed view

and to display the signal using .



Signal view

9.1.4. Description of a post-processing order extraction

❶ **Open** one or several measurement sessions and **select** Signal/Speed profile elements for analysis.

❷ Open the post-processing order extraction window using **Analysis / New analysis set-up**.

❸ : Retrieve selected Signal and Speed profile elements from the active session,
and/or
use the **batch** window to:

- view elements to analyse
- group Signal and Speed Profile elements two by two (1 Signal + 1 Profile) or three by three (2 Signals + 1 profile – two-channel recording)
- import other Signal elements from an open session
- deactivate analysis for one of the elements

❹ Set **processing parameters** (F5)

Analysis and storage parameters (see Section 11.2.2.2)

❺ Set display (see Section 11.2.3.1)

Display speed meter

View signal

❻ **Processing** of recordings

Start processing according to defined parameters (F3)
Stop processing (F4)

Display of the speed variation within the defined range

Decision

Transfer results in a measurement session (F7)

Discard current results

10. REMOTE CONTROLS AND DBFA

It is possible to use remote control objects with 01dB-Metravib PC-based measurement systems to control the measurement process (start data logging, run measurements from the sound intensity probe handle, etc.) or to enable a specific event when a user-defined condition is fulfilled (wait for measurement, notify an overload, etc.).

The interface between a physical remote control and the measurement system is performed either by the RS232 serial interface of the computer or the digital inputs / outputs of the acquisition unit. In the measurement software module, at the hardware configuration stage, a remote control object can be defined.

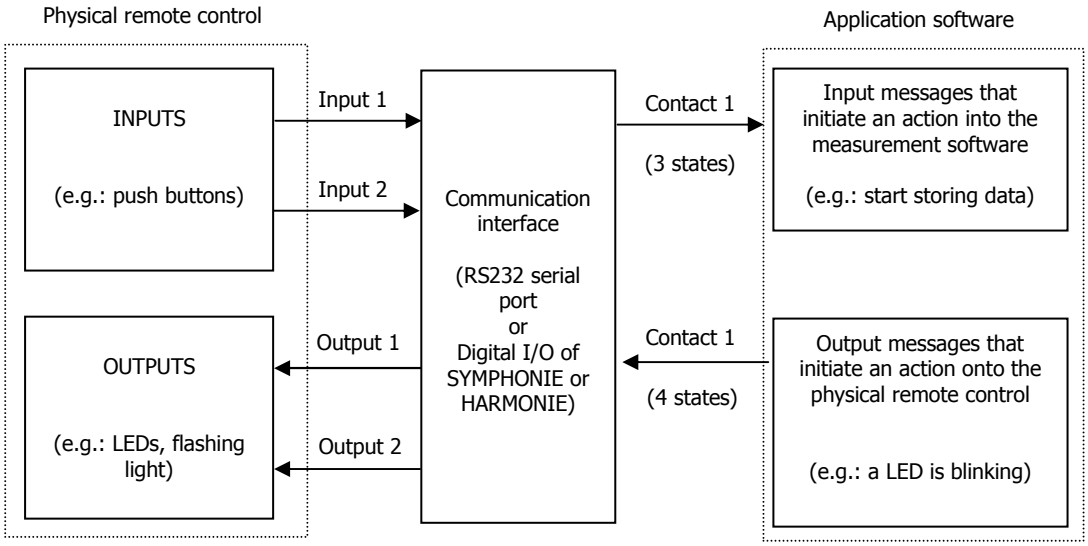
We describe in this chapter the generic remote controls of **dBFA** (definition, configuration and operating mode).

Then, we present various applications for **dBFA** remote controls:

- Remotely control the acquisition process for sound intensity and sound power (ISO9614) measurement with the keys of the probe handle.
- Remotely control the acquisition process with a generic device attached to the acquisition peripheral.
- Triggering signal recordings from a simple one button physical remote control.

The electrical drawings of the physical remote controls and the communication interfaces (RS232 port, **SYMPHONIE** or **HARMONIE** digital inputs / outputs) are also given.

10.1. Definition of a generic remote control object



A generic remote control object for 01dB-Metravib programs is made of 2 physical inputs and 2 physical outputs. It features **16 input functions** and **16 output functions**, each one of them having a START and a STOP state.

It means that **32 input messages** can be received by an application software by mean of the remote control object (to remotely control the measurement for example) and **32 output messages** can be sent by the application software to a physical remote control (to trigger a light alarm for example).

Messages are assigned to each **contact** (corresponding to an input or an output of a physical remote control) in order to perform a specific operation.

The input contacts (generally connected to push buttons of a physical remote control) can present 3 different states : click, double click and long push of a button. An input message is assigned to each state.

The output contacts (generally connected to flashing lights or LEDs) can present 4 different states: active, inactive, blinking and flash. A contact state is assigned to an output message.

In fact, each contact corresponds to a specific pin of the communication interface (RS232 connector of a microcomputer, MiniDyn connector of the **SYMPHONIE** or **HARMONIE** acquisition unit).

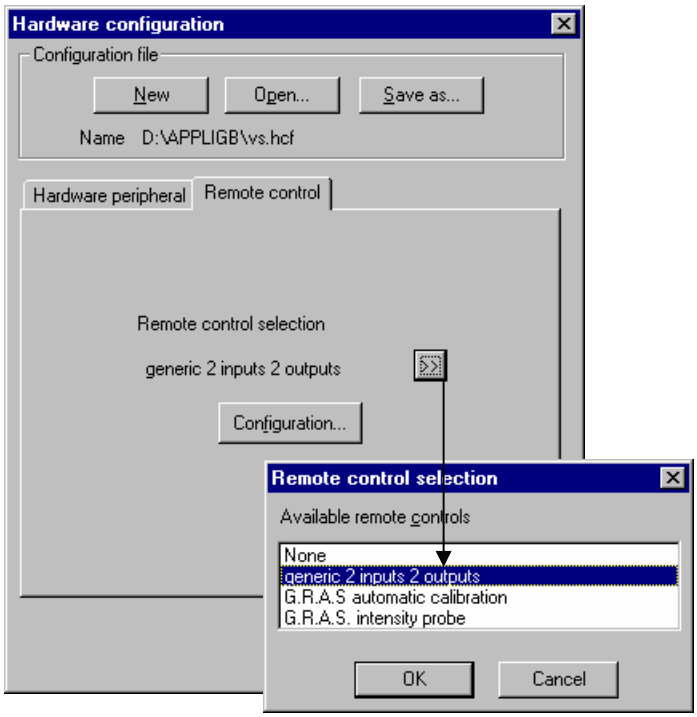
When an input contact is activated, a voltage is generated on this pin. This voltage is then interpreted by the remote control object and the application software execute the appropriate input message.
When an output message is sent by the application software to the remote control object, the output contact is activated and, depending on its state, a voltage is generated on the pin of the communication interface. This voltage signal is then interpreted by the physical remote control.

Remote control objects are defined in the file DBCD32.INI. If you do not have this file in the 01dB-Metravib program folder, contact 01dB-Metravib technical support to obtain a copy of it. A complete description of this file is given in this manual.

Follow the procedure below to define a generic remote control object :

1. Selection of the remote control
2. Configuration of the remote control
3. Assignment of the input functions
4. Assignment of the output functions
5. Configuration of event triggering parameters in the application software (if required)
6. Use of the remote control

10.1.1. Selection of a generic remote control



At the hardware configuration stage, select the **remote control** tab (shown only if the DBCD32.INI file is present in the 01dB-Metravib programs directory). The dialog box shown aside is displayed on screen.

Click on the **>>** key, and select the remote control type **generic 2 inputs 2 outputs** and click on OK.

The specific remote control **G.R.A.S automatic calibration** and **G.R.A.S intensity probe** are predefined object to respectively activate the electrostatic actuator of the GRAS outdoor microphone units (41AM and 41CM) automatically from the application software **dBTRIG32** and to drive sound intensity and sound power measurements from the 50AI intensity probe handle in **dBFA**.

After the selection of the remote control, configure its parameters.

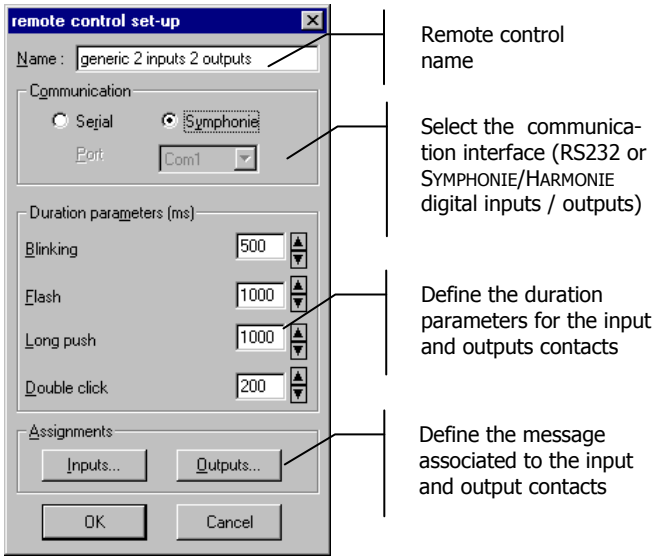
10.1.2. Configuration of a generic remote control

After the selection of the remote control, click on the **Configuration** key to configure the remote control object parameters. The following dialog box appears on-screen:

Define in this dialog box the **name** of the remote control and the **communication** interface to use (either a **Serial** port or the **SYMPHONIE** or **HARMONIE** digital inputs / outputs).

The **duration parameters** refer to the states of the input and output contacts of the remote control.

In the example shown aside, and for input contacts, the state **Long push** corresponds to a continuous essential push of 1000 ms minimum; the state Double **click** corresponds to two successive key push of time interval less than 200 ms.



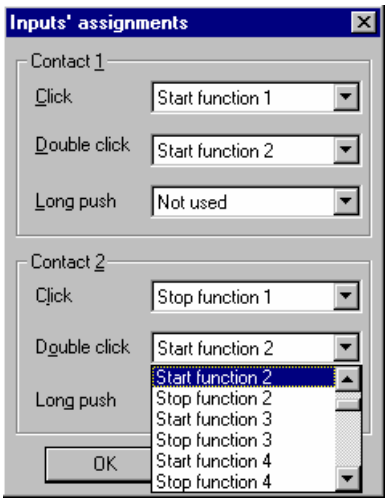
For output contacts, the state **Blinking** generates a voltage on a pin of the connector of the communication interface every 500 ms and the state **Flash** generates a voltage on this pin for 1000 ms only one time.

The configuration of the input and output functions can be accessed by the keys **Inputs** and **Outputs**.

10.1.3. Assignment of input functions

After configuration of the general parameters of the remote control, define which input function will be assigned to each input contact. Access the dialog box shown below by the **Inputs** key.

Select for each state of an input contact a function in the list of input functions. The input contacts present three different states:



- **Click: Simple push of a key**. The voltage on the appropriate pin of the connector of the communication interface passes from 0V to 9V (RS232) or 5V (SYMPHONIE/HARMONIE) while the key is pushed.
- **Double click: Two successive pushes of a key**. The voltage on the appropriate pin of the connector of the communication interface passes from 0V to 9V (RS232) or 5V (SYMPHONIE/HARMONIE) twice over a user-defined time interval.
- **Long push: Continuous push of a key.** The voltage on the appropriate pin of the connector of the communication interface passes from 0V to 9V (RS232) or 5V (SYMPHONIE/HARMONIE) twice over a user-defined period.

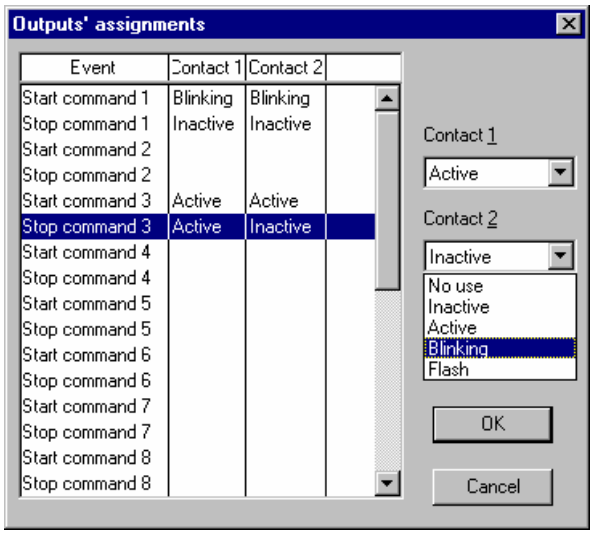
When one of these states occurs, an input message will be interpreted by the application software. The table below shows a list of the actions that will interpreted by **dBFA** for each input function:

FUNCTION , STATE	ACTION
MEASUREMENT - STORAGE	
Start function 1	Start or accept a measurement (data logging)
Stop function 1	Stop or reject a measurement (data logging)

10.1.4. Assignment of output functions

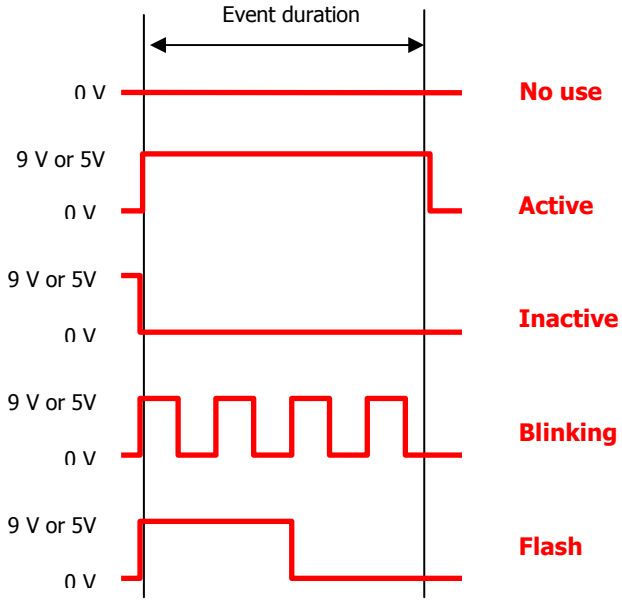
After configuration of the general parameters of the remote control and the input contact assignments, define the assignment of the output contacts that the application software will send to the physical remote control when a user-defined condition has been fulfilled (for example, activation of a LED when a measurement result has to be validated). Access this dialog box by the **Outputs** key.

For adequate output functions (or events), define the state of each output contact. Output contacts present four different states:



- **No use.**
- **Active.** While an event is activated, the voltage on the appropriate pin of the connector of the communication interface passes from the current state to 9V (RS232) or 5V (SYMPHONIE/HARMONIE).
- **Inactive**. While an event is activated, the voltage on the appropriate pin of the connector of the communication interface passes from the current state to 0V.
- **Blinking**. While an event is activated, the voltage on the appropriate pin of the connector of the communication interface passes from 0V to 9V (RS232) or 5V (SYMPHONIE/HARMONIE) at a user-defined rate.
- **Flash**. While an event is activated, the voltage on the appropriate pin of the connector of the communication interface passes from 0V to 9V (RS232) or 5V (SYMPHONIE/HARMONIE) for a user-defined period.

The drawing below illustrates the different states of the output contacts:



For **dBFA**, the table below gives the list of actions for each output contact:

FUNCTION , STATE	ACTION
MEASUREMENT - STORAGE	
Start command 1	Notify the remote control that the application software waits to start an acquisition
Stop command 1	Notify the remote control that an acquisition is in progress
Start command 2	Notify the remote control that the application software waits to accept / reject the measurement result
Stop command 3	Notify the remote control that an overload occurred during acquisition
CALIBRATION	
Start command 5	Notify the remote control that calibration is in progress
Stop command 5	Notify the remote control that calibration is finished

No specific software configuration is required in **dBFA**.

10.1.5. Operating process

Once a remote control object has been completely configured and (if required) once triggering parameters have been defined in the application software, the operator may use the remote control. The operating process is very simple.

Simply connect the physical remote control to the communication interface that was selected. When the triggering conditions are fulfilled, or when the user clicks on a button, the physical remote control or the software executes the actions defined.

📖 *Consult the examples for more information on the use of the remote controls.*

If you wish to develop a physical remote control for specific needs, do not hesitate to contact your 01dB-Metravib representative to discuss your application.

📖 *Consult the connection diagrams of the communication interface as well.*

10.2. Description of dBCD32.INI

The dBCD32.INI file contains information relative to the definition of remote control objects used in 01dB-Metravib measurement software programs. The syntax in the file is as follow:

[Com Device]
Count=4

It is the **number of remote control objects** defined in the file. They are numbered in this example from 0 to 3 - therefore a total of 4 objects. This number is incremented each type a new remote control object is defined.

[CDEV 0]
Type=1

This is the **type of remote control**. Type = 1 define a generic 2 inputs 2 outputs remote control.

Name= generic 2 inputs 2 outputs
Comm=-1
Clign=500
Flash=1000
Appui=1000
DblClk=200

These parameters are defined in the **configuration of the remote control** (name, communication port, and duration parameters). See paragraph 10.1.2

Fct Clk0=0
Fct DblClk0=0
Fct Appui0=0
Fct Clk1=0
Fct DblClk1=0
Fct Appui1=0

These parameters are defined in the **configuration of the input contacts, associated to an input message** (See paragraph 10.1.3). The number corresponds to one of the 32 input messages. It varies between 0 (not used) and 32 (stop function 16).

Out1_9=2
Out2_9=2
Out1_10=1
Out2_10=1
Out1_15=2
Out2_15=1
Out1_16=1
Out2_16=1
Out1_17=2
Out2_17=1
Out1_18=1
Out2_18=1

These parameters are defined in the **configuration of the output contacts** (See paragraph 10.1.4). A state of an output contact is associated with this output messages. The number corresponds to one of the 32 output messages. It varies between 0 (not used) and 32 (stop command 16).

[CDEV 1]
Type=7
Name= G.R.A.S automatic calibration
Comm=-1

This specific remote control is used to activate an electrostatic actuator of GRAS outdoors-permanent microphone units 41AM/CM in **dBTRIG32**.

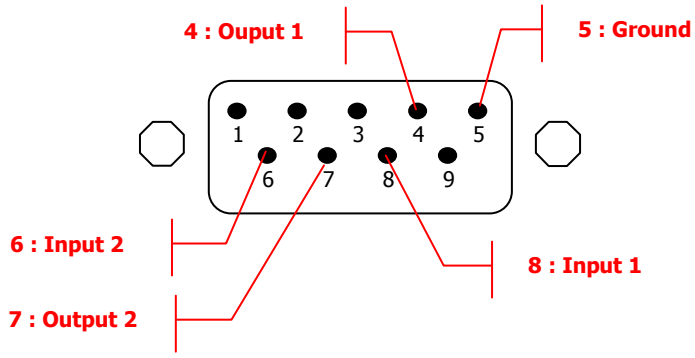
[CDEV 2]
Type=2
Name= G.R.A.S. sound intensity probe
Comm=-1
Clign=500
Flash=200
Appui=1000

This specific remote control is used to control measurements of sound intensity and sound power in **dBFA** from the handle of a GRAS sound intensity probe 50AI.

10.3. Communication interface

Find in this paragraph the electrical drawings that indicate which pins correspond to input and output contacts of a generic remote control.

10.3.1. For a RS232 9-pin serial port (male connector on the PC)

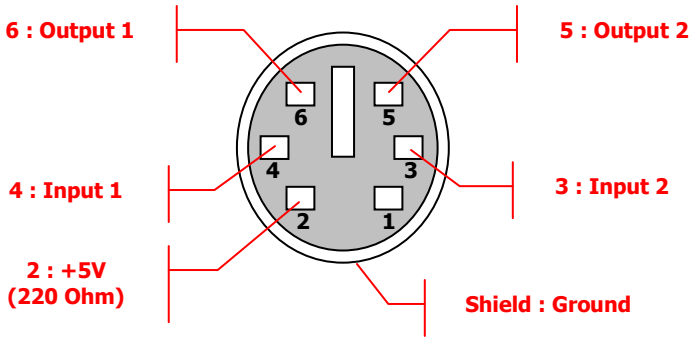


Input contact n°1	Pin 8
Input contact n° 2	Pin 6
Output contact n°1	Pin 4
Output contact n°2	Pin 7
Ground	Pin 5

The generated output signal from a RS232 serial port varies from -9V or -12V (lower state) to +9V or +12V (higher state) for a current of 5mA.

🕮 *In most cases, an input remote control requires a 9V-power supply for the push key. This voltage is not supplied by the RS232 interface. A solution is to generate an output signal on the RS232 interface (output contact always activated) and to power supply the push key with it, or to use a capacitance network or a battery.*

10.3.2. For SYMPHONIE digital inputs / outputs (female MiniDyn connector)



Input contact n°1	Pin 4
Input contact n° 2	Pin 3
Output contact n°1	Pin 6
Output contact n°2	Pin 5
Ground e	Body
Signal (+5V / 20mA)	Pin 2

The generated output signal from the MiniDyn connector varies from 0V (lower state) to +5V (higher state) for a current 20 mA.

Pin 2 of the MiniDyn connector always supply +5V / 20 mA in order to power supply various elements of the physical remote controls connected to it.

10.4. Remote control examples

In this paragraph, we give several examples to define, configure and use a remote control object in the application software **dBFA**. All the electrical drawings of the physical remote controls evoked are also given.

- Specific remote control for sound intensity and sound power (according to ISO9614) measurement, with a GRAS 50AI sound intensity probe
- 1 button, 2 LEDs remote control to manually start signal acquisition
- 2 buttons, 2 LEDs remote control for real-time acquisition

10.4.1. Specific remote control of measurement process with a 50AI sound intensity probe

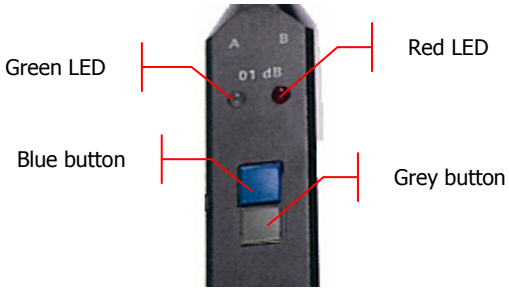
If you are using a sound intensity probe type **GRAS 50AI** with a remote control, the measurement process is simplified because the operator does not need to use the keyboard or the mouse to start, stop, validate a measurement.

The remote control is very useful if the source under test is located at a certain height or in a location difficult to access.

The photograph shown aside features the sound intensity probe **50AI** with the connection box for the Symphonie acquisition platform.

The handle of the sound intensity probe features two remote control buttons that can be used to pilot the acquisition process and two LEDs to inform the user on the measurement progress:

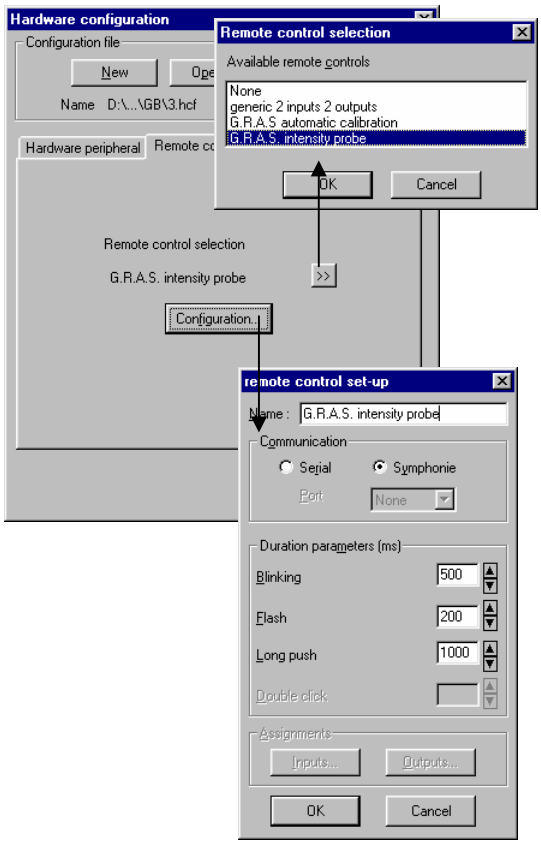
- The upper button (blue) is a 'positive' button: it is used to start and validate a measurement result.
- The lower button (grey) is a 'negative' button: it is used to prematurely stop an acquisition or to repeat the current measurement.
- The left LED (green) and the right LED (red) are used to indicate the different states of the sound intensimeter (waiting for measurement start, acquisition ended, overload)



To configure this remote control, perform the following operations:

- Choice and configuration of the remote control object
- Assignments of input and output contacts
- Connection and operating process

10.4.1.1. Choice and configuration of the remote control object



At the hardware configuration stage, select the **remote control** tab (shown only if the DBCD32.INI file is present in the 01dB-Metravib programs directory).

Click on the **>>** key, and select the remote control **G.R.A.S. sound intensity probe** and click on **OK.**

After the selection of the remote control, click on the **Configuration** key and select the communication port **Symphonie**. The physical remote control (built-in the probe handle) will be connected to the digital inputs / outputs of the acquisition unit with the interface box.

Define the duration parameters **Blinking** and **Flash**, corresponding to the two output states, and **Long push**, corresponding to one of the two input contacts according to your specific needs.

The functions' assignments of the inputs and the outputs of this remote control cannot be modified. Refer to the example described in **paragraph** Erreur ! Source du renvoi introuvable. for a detailed description of these functions to remotely control the measurement process during real-time acquisition in **dBFA**.

10.4.1.2. Connection and operating process

Once the remote control is configured, switch on the measurement system and connect the probe to the acquisition unit with the interface box (channel 1, channel 2 and digital inputs / outputs). Start a real-time acquisition in the intensity mode or ISO9614 mode.

Then proceed as follows:

❶ Place the sound intensity probe at the first measurement location. When the **Green LED blinks**, it means that the system is waiting to start an acquisition.

❷ Press the **Blue button**. The acquisition starts. At the end of the acquisition, the **two LEDs blink**. It means that the system waits for a decision:

- **Validation** of the measurement by the **blue button**
- **Repetition** of the measurement by the **grey button**

❸ Whatever the choice, the system waits for another measurement start action: for the same measurement point if the last acquisition has been eliminated, for the next measurement point if it has been validated.

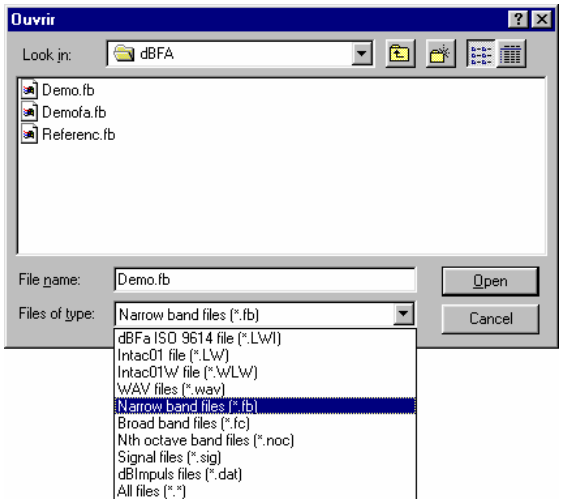
The **Red LED** indicates a possible overload during acquisition.

❹ Perform the measurement again for each point.

11. APPENDICES

11.1. Importing datafiles

For users that evolved from a 01dB-Metravib measurement system in a DOS version or Windows 16bit version to the 32bit software versions, it is possible to import data files to the new format. Use the command **File / Import** from the adequate software package.



In **dBFA**, the dialog box shown aside appears on screen.

Select the adequate folder on the computer hard disk where the files to import are located then click on the **Open** key.

The data is converted to the new datafile format. A new measurement session is created to store the data, or the data is stored into a measurement session already opened.

The table shown below gives a list of old datafiles that can be imported in **dBFA**:

File / Function	Origin
Files *.SIG Signal recordings (audios)	**dBARIA**
Files *.DAT Impulse responses	**dBIMPULS**
Files *.WAV Signal recordings (audios) in Windows format	**dBFA, dBTRIG, dBBATI**
Files *.FB Narrow band spectra catalogue	**dBFA**
Files *.FC Broad band spectra catalogue	**dBFA, dBBATI**
Files *.NOC Broad band spectra catalogue (1/Nth octaves)	**dBFA, dBAUDIO**
Files *.LWI Sound power measurements according to ISO9614	**DBFA**
Files *LW and *.WLW Sound power measurements according to ISO9614	**INTAC**
Files *.LOG Files in SONY © PC Scan II format	**PC Scan II software**
Files *.MP3 Files in MPEG Layer III format	**Any program handling MP3 format**
Files *.HDR Files in TEAC format	**TEAC**
Files* .DAC Files in nSoft format	**Nsoft**
Files *.UFF Files in Universal File format	**Any program handling UFF format**
Files *.SIG; *.ASP; *.COH; *.TRF; *.TF; *.ISP Files in Lexade format	**Lexade**
Fichiers *.NTR Files NetdB	**dBRecorder**
Fichiers *.OPE Files Opera	

11.2. Import WAV or NTR format

To import a WAV or NTR file, dBFA suggests to split channels, if the need arises, knowing that one item cannot exceed 500Mo and that time display y= F (T) of item of size > 30Mo is not recommended.

Example:

- Optional split, channels are 25Mo: storable and displayable
- Necessary split, channel are 1024Mo. A split in 3 items is necessary (500, 500, 24). To display channels, a spilt in 35 items/channels is necessary .

Item which isn't displayable can be used for post-processing (LEQ, spectra, etc)

11.3. Frequency weightings

First, here is the list of all the frequency weightings available to calculate overall levels:

- **A weighting**: Sensitivity of the human ear at low levels
- **Lin weighting**: No weighting (linear)
- **B weighting**: Sensitivity of the human ear at medium levels
- **C weighting**: Sensitivity of the human ear at high levels
- **G weighting**: Infrasound weighting
- **Pink Lin weighting**: Global Lin with respect to pink noise
- **Road Lin weighting**: Global Lin with respect to road traffic noise
- **Pink A weighting**: Global A with respect to pink noise
- **road A weighting**: Global A with respect to road traffic noise
- **PL weighting**: Correspond to a Loudness acquisition channel displayed in dB equivalent
- **PN weighting**: Correspond to a Perceived noise level (PNL) acquisition channel displayed in dB equivalent
- **TPN weighting**: Correspond to a Perceived noise level Tone corrected (PNLT) acquisition channel displayed in dB equivalent

The following vibration frequency weightings can be selected:

ISO2631 part 1

- **Principal weightings Wd** (horizontal vibrations) **and Wk** (vertical vibrations) to evaluate the adverse effects of vibrations on human beings relative to health, comfort and perception issues.
- **Additional weighting Wc** (seat back vibration measurement), **We** (rotation vibration measurement) and **Wj** (vibration measurement under head of recumbent person) related to comfort issues, in specific cases.
- **Principal weighting Wf** to evaluate the adverse effects of vibrations on human beings relative to motion sickness
- **Principal weighting Wb** to evaluate the adverse effects of vibrations on human beings relative to comfort issues in given environments (vehicles on rails, for example)

ISO8041 (and ISO2631 part 2)

- **Principal weighting WBc** (all directions combined) to evaluate the adverse effects of continuous and shock-induced (1Hz to 80Hz) vibrations in buildings.

ISO8041 (and ISO5349)

- **Hand-arm weighting Wh** (all directions) to evaluate hand-transmitted vibrations.

11.4. Spectral units / display types

For **signals**, it is possible to select the following display units:

- **ADC**: Displays the dynamic in dB converter. It is a relative decibel level. The 0dB level is the full scale value of the converters (i.e., a sample which has a numerical value of 2 16 (32767) corresponds to the 0dB value). dBADC values are always negative between 0 and -90dB.
- **V**: Dynamic display in Volts.
- **Physical unit**: If the transducer is a microphone, the dynamic is displayed in Pascals (**Pa**), If the transducer is an accelerometer, the dynamic is displayed in Acceleration (**m/s²**).

For sound and vibration quantities of type autospectrum, cross-spectrum and transfer functions, it is possible to select the following display units:

- **dB**: Level in decibels of the considered quantity (Leq, Slow, Fast, Impulse, etc.)
- **RMS (Root Mean Square)**: Average quadrature value for all the instantaneous squared values expressed in physical units.
- **PWR (Power)**: The power represents the average of a squared value. It is the unit used to determine the power at a given frequency for a determined (sinusoidal) signal. It is expressed in squared units
- **PSD (Power Spectral Density)**: This unit is used to determine the power in a frequency band for a random signal. It is expressed squared units by Hertz.
- **ASD (Amplitude Spectral Density)**: This unit represents the square root of the power spectrum density. It is the unit used to find the amplitude in a frequency band for a random signal. It is expressed in square rooted units per Hertz.
- **ESD**: Unit representing the power spectral density multiplied by time and expressed Unit² x second / Hz.

11.5. Structure of measurement session data files (.CMG)*

This chapter describes the structure of the datafiles, as well as all the resulting processing operations.

❑ Measurement session

The first requirement in the definition of this format was to identify a structure of the "container" type, intuitive enough for being used by an non-experienced operator, and flexible enough to store all type of noise, vibration and other quantities measured by 01dB-Metravib systems. We therefore decided to call this type of file "measurement session".

A measurement session is therefore defined by its name (generic root name), a comment (to fully describe the context of a measurement).

But what do we found in a measurement session file and how do we handle the data?

Going down one level in the structure, we reach the heart of the data file structure that is the elementary entity used to store a given type of data. **This generic entity is called an ITEM. Its structure is identical for all quantities stored in a measurement session**.

Physical data storage of the items is not shown to the user. Depending on the requirements of the application software used, the measurement sessions, which reference in its header all these item boxes, will contain the complete set of measured quantities in a single file or in individual files (one by item). In both cases, later computing operations (file copies, architecture on the computer hard disk, etc.) will be easier to integrate and to perform.

❑ Item

Let us now describe this structure : the item is a stand-alone quantity that must be able to contain any type of data sets (description, metrological and reference information, actual measurement values) in order to address the present and future measurement applications.

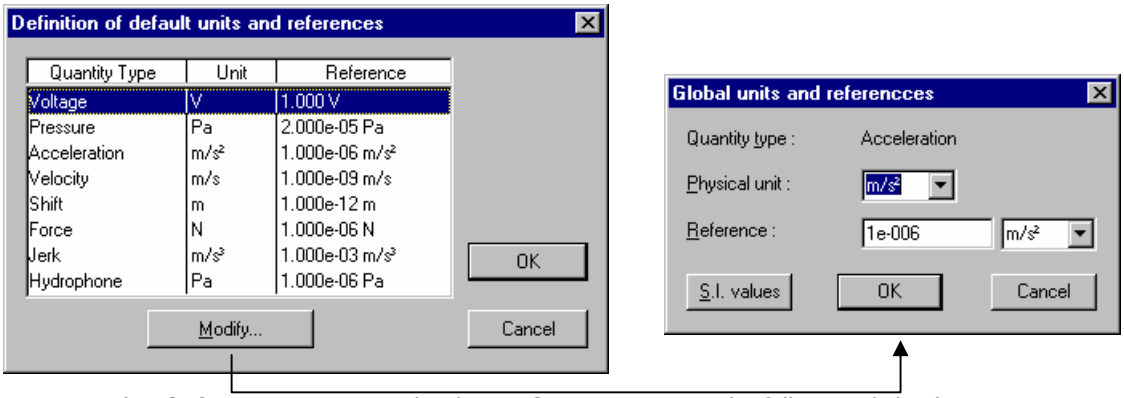
A non-exhaustive list of items currently stored as items is given below.

The following quantities, measured by 01dB-Metravib systems, can be stored as items of a measurement session data file:

- Signal recordings
- Impulse responses acquired by MLS technique
- Time histories of overall quantities: Overall levels (frequency and time weighted), civil aviation criteria (PNL,PNLT), psychoacoustic criteria (Loudness, Sharpness, etc.), spectral time history
- Autospectra and cross spectra, in real or complex narrow bands, time averaged or not, computed in real time or off-line
- Broad band spectra (from octave to 1/48th octave resolution), computed in real time or off-line
- Bark band spectra (specific Loudness)
- Transfer functions (cross-spectra, coherence, etc.)
- Noise source codes
- Measurement chain information (dynamic range selection, overload, etc.)
- Comments
- Table of results (psychoacoustics)
- Histograms
- Echograms
- Room acoustic criteria
- etc.

The container therefore has a database structure well adapted to handle batch processing, for example.

11.6. Conversion units and references management (from a physical unit to a dB level)



Use the command **Units' management** under the **Preferences** menu. The following dialog box appears on-screen:

dBFA allows to define default units and references used for each type of metrics. Also it is possible to define export and "copy/paste" units for spectra and overall levels, either physical units or dB.

Click on **modify** to edit the **physical unit** and/or the **reference** value of the selected quantity in the list, as well as the **export** unit. Click on **IS values** to select the values of the International system as standard.

This function cannot be accessed when a measurement is running. Close the measurement window to edit the references values and the units.

Let us consider an example of conversion.

For pressure type transducers, the reference value of the SI system is $2*10^{e-5}$ Pa. The sound pressure level is given by the formula :

$Lp = 10 * \log (p^2/p_0^2)$ where p_0 is the reference value

Therefore, for an acoustic pressure level of $2*10^{-2}$ Pa, **dBFA** will use a reference of $p_0=2*10^{-5}$ Pa, to calculate a sound pressure level of 60 dB (that is $10*\log[2(10^{-2})^2/2(10^{-5})^2]$).

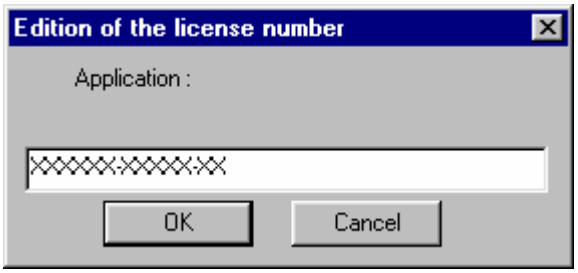
If one define a reference level of $p0=2*10^{-6}$ Pa, the sound pressure level displayed in **dBFA** will be equal to 80 dB.

Likewise, it will be possible to edit these parameters for each type of transducer, depending on the application.

11.7. Editing of the software licence number

Use this command (menu **? / About dBFA**) to obtain general information on the software version, copyright and licence number.

If the licence number of the software module has to be modified, click on the key Licence number. The following dialog box appears on screen:



Enter the new licence number, provided by 01dB-Metravib technical support.

Start again the application software in order to account for this modification.

11.8. Generating signals with dBGENE

The **dBGENE** software is used to generate different types of signals via the computer sound card or the acquisition platform. An amplified loudspeaker or even a shaker can thus be controlled.

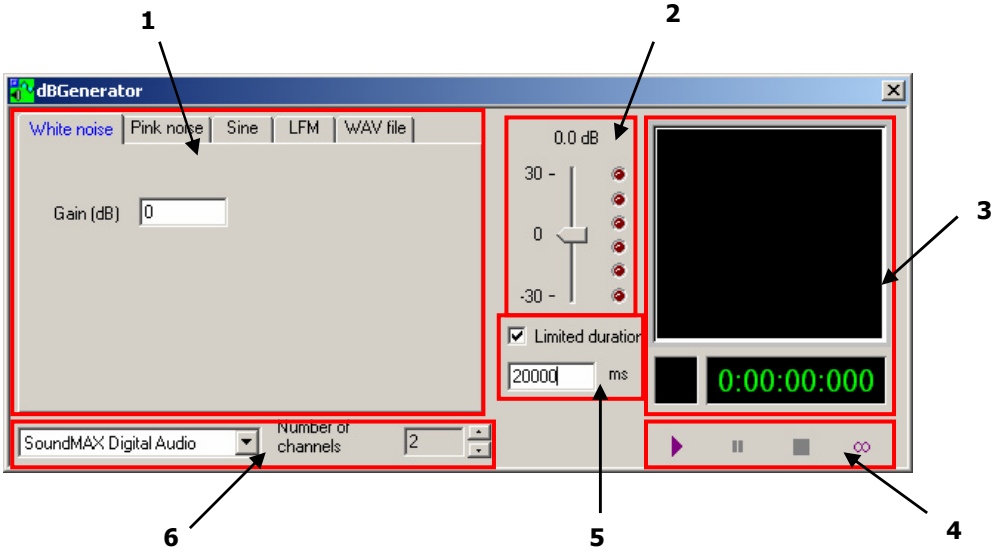
The following signals can be generated by dBGENE:

- White noise
- Pink noise
- Sine
- Frequency modulation
- Playback of *.WAV files

*Generating a signal on the acquisition platform is only possible with **SYMPHONIE** or **HARMONIE**, with Windows 98 and Windows Me.*

11.8.1. Presentation of dBGENE

The figure below shows the overall interface of dBGENE, from which all generator functions are available:



❶ Select and define parameters for the signal to generate.

❷ Set the general output level. This control is active during emission so that the general volume can be adjusted at any time. The 0 dB value corresponds to the maximum amplitude that can be generated by a sound card without saturation (according to the model).

❸ Real-time display of the shape of the generated signal, of the time elapsed and of the generator status.

❹ Generator control bar:

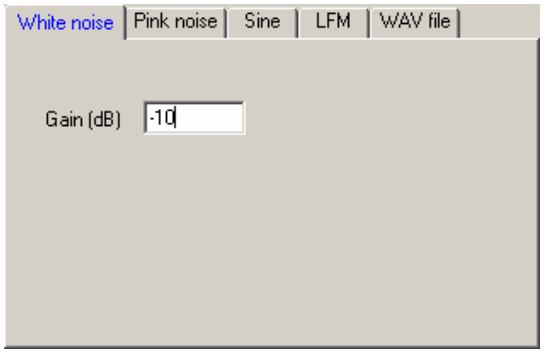
- ▶ launch emission for a limited time or not (according to ❺),
- ⏸ pause before a possibly resuming emission,
- ■ stop emission,
- ∞ launch emission for an infinite time, regardless of the parameters.

❺ Define a time limit for the emission. Check the **Limited time** box and enter a time in **ms**.

❻ Select the output peripheral device (PC sound card or acquisition platform) and the number of channels to use.

11.8.2. Generating white noise

To generate a white noise, click on the **White noise** tab:

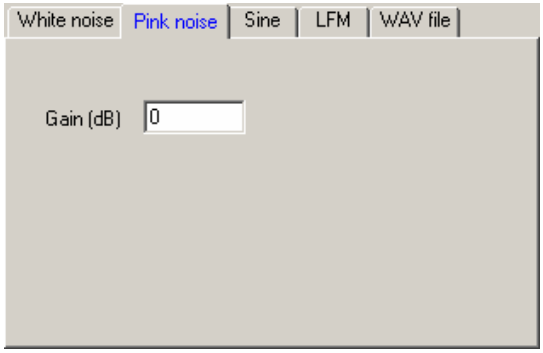


- The **gain** is the only parameter that can be set for the generation of white noise. A gain of 0 dB corresponds to the maximum amplitude that can be generated by a sound card without saturation (depending on the model).

Once signal parameters are set, use to launch the emission.

11.8.3. Generating pink noise

Click on the **Pink noise** tab o generate pink noise:

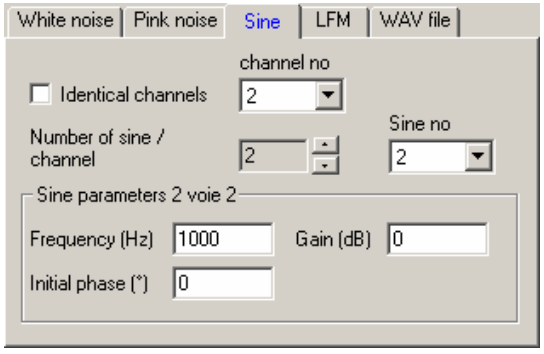


- The **gain** is the only parameter that can be set for the generation of white noise. A gain of 0 dB corresponds to the maximum amplitude that can be generated by a sound card without saturation (depending on the model).

Once signal parameters are set, use to launch the emission.

11.8.4. Generating sine noise

Click on **Sine** to generate a Sine. Several different frequencies can be generated simultaneously on the same channel and each channel can be set up separately.

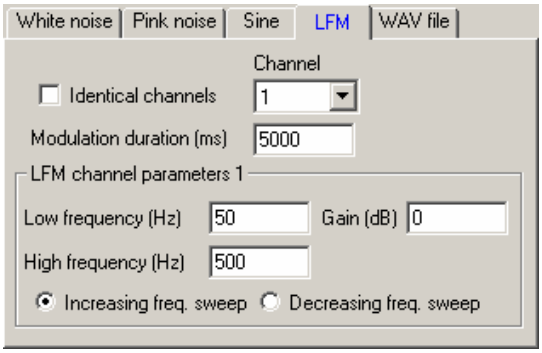


- **Identical channels / Channel No.**: If at least 2 channels are used, different signals can be generated on each channel. Select the channel to configure, if you wish to configure each channel independently.
- **Number of sine / channel**: Indicate the number of sine to generate on each channel.
- **Sine no.**: To configure each frequency, select the no. of the sine to configure.
- **Parameter of sine X on channel X**: Enter the frequency, the initial phase and the gain or the selected sine.

Once signal parameters are set, use to launch the emission.

11.8.5. Generating frequency modulation

Click on the **MLF** tab to generate a frequency modulation. A different frequency modulation can be generated on each channel.

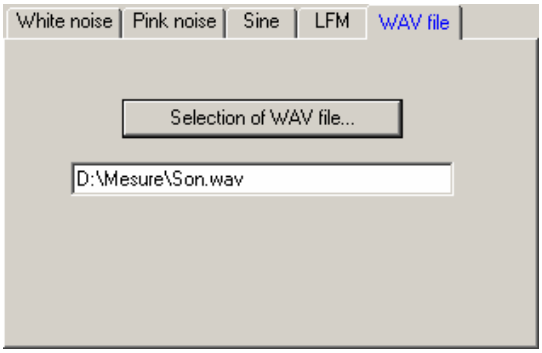


- **Identical channels / Channel No.**: If at least 2 channels are used, different signals can be generated on each channel. Select the channel to configure, if you wish to configure each channel independently.
- **Modulation time**: Enter the sweep time in **ms**.
- **MLF parameters**: Enter the lower and the upper frequency, as well as the gain and the sweeping direction for the modulation.

Once signal parameters are set, use to launch the emission.

*11.8.6. Generating a *.WAV file*

To generate a signal resulting from a *.WAV file, click on the **WAV file** tab.



- Click on **WAV file selection...** and open the file.

Once signal parameters are set, use to launch the emission.